The Only Noninvasive Way to Overcome Heart Disease

HEAL Your Heart *with* EECP

The First Comprehensive Guide to Enhanced External Counterpulsation

"A clarion call to utilize a therapy that could replace most of the drugs and virtually all of the surgical procedures currently used to treat cardiovascular disease."

—Julian Whitaker, MD, from the foreword

Debra Braverman, MD

LARGE PRINT NONFICTION

HEAL YOUR HEART WITH EECP
The Only Noninvasive Way to Overcome Heart Disease
Debra Braverman, M.D.

If you suffer from or are at risk for heart disease, surgery and invasive procedures are not your only options. There is a noninvasive, safe and painless treatment that is clinically proven to be more successful in reversing the effects of the disease, improving blood circulation, and strengthening the cardiovascular system, all for a fraction of the medical costs. Using blood pressure cuffs to help push blood through the body, enhanced external counterpulsation (EECP) promotes the development of new blood vessels to naturally bypass coronary blockages, restoring the flow of healthy, oxygenated blood to the heart. Now, Dr. Debra Braverman dispenses critical information about this revolutionary treatment.

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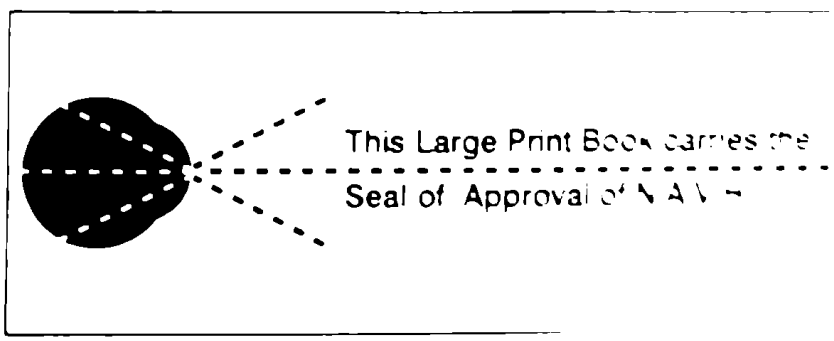
ISBN 0-7862-8840-X

U.S. Hardcover ISBN 0-7862-8840-X

9 780786 288403

Thorndike Press

HEAL Your Heart *with* EECP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The Only Noninvasive Way to Overcome Heart Disease

DEBRA BRAVERMAN, MD

Edited by Melissa Levy

Foreword by Julian Whitaker, MD

Thorndike Press • Waterville, Maine

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Published in 2006 by arrangement with Philip Wood Inc.

Thorndike Press® Large Print Home, Health, and Learning.

The tree indicium is a trademark of Thorndike Press.

The text of this Large Print edition is unabridged.
Other aspects of the book may vary from the original edition.

Set in 16 pt. Plantin.

Printed in the United States on permanent paper.

Library of Congress Cataloging-in-Publication Data

Braverman, Debra, 1966–
Heal your heart with EECP : the only noninvasive way to overcome heart disease / by Debra Braverman ; edited by Melissa Levy ; foreword by Julian Whitaker.
p. cm.
Originally published: Berkeley, Calif. : Ten Speed Press, 2005.
Includes bibliographical references and index.
ISBN 0-7862-8840-X (lg. print : hc : alk. paper)
1. Enhanced external counterpulsation — Popular works. 2. Heart — Diseases — Alternative treatment — Popular works. 3. Coronary heart disease — Alternative treatment — Popular works. I. Levy, Melissa. II. Title.
RC684.E53B73 2006
616.1'206—dc22 2006014992

This book is dedicated to Allen Braverman. His strength of mind, body, and character have been a constant source of inspiration for me. His unconditional love and support has fueled my journey. He is my father, my partner, and my friend.

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Acknowledgments

First and foremost, this book would not exist without the dedication and collaboration of my colleague, Melissa Levy. We have spent countless hours brainstorming, writing, and editing together. She has been a tireless sounding board and springboard for ideas. Her commitment to our mission — to educate, to inspire, and to change the status quo — is unshakable.

I thank my agent, Jeanne Fredericks, for sharing our vision and dedication to this project. I am grateful for her guidance and for her achievement in finding the right home for this book.

I thank our editor, Brie Mazurek, and publisher, JoAnn Deck, at Celestial Arts. Their enthusiasm for this book was evident from the start. Their energy and effort toward making the final product the best it could be have been deeply appreciated.

I thank my patients, who, despite their pain and suffering, demonstrate daily the triumph of the human spirit. The spark of hope in their eyes inspires me to continue my work each and every day.

I thank my valuable staff at Braverman EECP Heart Centers for providing consistently outstanding care to all of our patients with compassion and devotion. I especially thank Arvina Farooqi, my nurse practitioner and clinical associate, who has worked beside me from the beginning and has played an integral role in developing our standards of excellence in treating patients with EECP.

I thank my mother, Annette, who has offered unconditional encouragement, as always, during the writing of the book.

Lastly, I thank my family, Sharon and Ari. Their unbelievable patience, constant support, and keen editing skills have made this book possible.

— Debra Braverman, MD

I gratefully thank: Debra Braverman, for inviting me on this journey, and for lots of laughter along the way. With her integrity, compassion, and clarity, she embodies the very best of what it means to be a physician. There is no one better suited to lead us on this adventure.

Allen Braverman, for his trust, wisdom, and guidance. For opening the door, and asking me to change direction when I least expected it.

My parents, Harriet and Steve, for giving me the tools to think critically, feel deeply, and remember what really matters.

Mike, for always challenging me to question.

Harper, for his unwavering encouragement, patience, kindness, and love.

— Melissa Levy

Foreword

Ten years ago Richard came to me in desperate straits. He had undergone two bypass surgeries and multiple angioplasties, but his symptoms of coronary artery disease had returned with a vengeance. Despite using a nitroglycerin patch, he had significant chest pain, and his exercise tolerance was so poor that he only lasted five minutes on an exercise stress test due to shortness of breath and chest tightness. Several cardiologists agreed that, thanks to extensive scar tissue from his previous procedures, repeat surgery was not an option. Richard was at the end of his rope.

This was about the same time I first heard about enhanced external counterpulsation (EECP). I was skeptical. Even though I had read glowing reports about this "new" therapy, in all my brilliance at the time I couldn't see how a simple mechanical treatment could do much for such an advanced case of cardiovascular disease. However, since I wasn't sure how much vigorous diet changes could help this very sick man, I suggested he give it a try.

I saw Richard after he completed his course of EECP, and the results were absolutely miraculous. His chest pain was gone, and his exercise tolerance was markedly improved. Furthermore, a repeat PET scan of his heart showed the growth of sufficient collaterals to relieve his chest pain. EECP had actually facilitated the growth of new blood vessels to bypass his blocked coronary arteries!

A few months later, I received a letter from Richard. He had moved to New Zealand, where he had bought a farm and was up to his elbows in manual labor. He wrote, "I must tell you the EECP certainly was a great success. There is no comparison in the way I feel now and then. No question about it, the 'big squeeze' was great."

This patient's experience convinced me of the value of EECP, and I have been utilizing it in my clinic ever since. This is a therapy that everyone — physicians and patients alike — needs to get to know, and I can think of no better place to start than *Heal Your Heart with EECP.*

In this book, Debra Braverman, MD, clearly describes the mechanics of this low-risk, noninvasive therapy and how it dramatically improves blood flow through-

out the body. She explains its potential in the treatment of a wide variety of diseases and shows how its enduring benefits allow patients to maintain function and reduce hospitalizations to a greater extent than other therapies for cardiovascular disease.

Dr. Braverman also writes a very thoughtful chapter on why EECP has not been embraced by conventional medicine. The answer is simple: It will never generate the kind of money that high-tech surgical procedures and expensive drugs generate. Never. In most cases, a full course of EECP costs a small fraction of an angioplasty or stent, and less than the sales tax on bypass surgery, and it can be administered outside a hospital by a nurse. All the plusses of EECP for the patient are minuses for conventional medicine.

Heal Your Heart with EECP is also Dr. Braverman's story. Having achieved her lifelong ambition of attaining a prominent place in academic medicine, she describes the joy she felt as she sat in her new office. She had arrived. Then something happened. She discovered a valuable therapy that could help untold numbers of patients. Safe, relatively inexpensive, easily administered — it had everything going for it. Then she discovered conventional

medicine's resistance.

Dr. Braverman eventually realized that she would have to leave academic medicine in order to become the physician she was meant to be. This book is a result of her subsequent experiences. It is not only a good read, easy to understand, and fascinating from beginning to end, but it also has an action plan that can dramatically improve and in many cases save patients' lives. For physicians, it is a clarion call to utilize a therapy that could replace most of the drugs and virtually all of the surgical procedures currently used to treat cardiovascular disease.

— Julian Whitaker, MD

Test Your Heart Disease Knowledge

True or False?

1. Many individuals with heart disease are not facing an urgent medical crisis and can safely delay surgery.
2. If you have smoked cigarettes for thirty years, it does not pay to quit because the damage has been done.
3. Both men and women should consume two alcoholic drinks per day to improve their blood pressure and cholesterol level.
4. The only type of exercise that provides cardiovascular benefit is thirty uninterrupted minutes of aerobic activity.
5. An LDL ("bad") cholesterol level of 75 mg/dL is desirable.
6. High blood pressure (hypertension) is commonly called the "silent killer" because it is often present without symptoms.

7. Bypass surgery is the best way to cure heart disease.
8. Those who exercise regularly not only feel better and look better, they are likely to live a lot longer than physically inactive people.
9. Angina may feel like indigestion or burning in the throat.
10. The movement to ban smoking in public places is driven by politics. There is no health data to support such bans.
11. If a severe blockage is identified on a cardiac catheterization, it must be corrected immediately with surgery, an angioplasty, or a stent.
12. Fatigue is the most common symptom of heart disease in women.
13. An angioplasty will remove a blockage from an artery.
14. Brushing and flossing your teeth daily and seeing the dentist every six months may lower your risk of many illnesses, including heart disease.
15. An HDL ("good") cholesterol level of 75 mg/dL is desirable.
16. A heart attack occurs when there is a

complete, sudden blockage in a coronary artery, leaving an area of the heart without blood flow.

17. According to the American Heart Association, more than one-third of all Americans lead a sedentary life with no leisure-time activity and no regular exercise.
18. Smoking is the leading preventable cause of death and disease in the United States.
19. Obesity and physical inactivity are two major risk factors for diabetes.
20. The blood pressure of an average healthy person is approximately 150/90 mmHg.

For answers, see page 349.

Getting to the Heart of Heart Disease

It is time to change our national discussion about heart disease. Our treatment approach is tragically outdated, which is why heart disease continues to be the most costly and deadly disease in the United States, claiming more lives each year — one every 45 seconds — than all forms of cancer *combined*. Currently, 13 million Americans (7.1 million men and 5.9 million women) live with heart disease. But we have the power — *today* — to strip this illness of its dubious distinction as our number-one killer and get heart disease sufferers back to living the lives so many have given up. It's not with a pill, a diet, an exercise program, or a hospital visit, but simply by aligning our treatment methods with our most current knowledge of the disease.

ON THE WRONG TRACK

For many years, scientists thought heart disease was a "plumbing" problem: they con-

sidered blockages in the heart arteries to be the source and definition of the disease. Therefore, heart disease treatments have historically focused on opening or bypassing one blockage at a time. But if heart disease is simply about blockages, and all of these procedures "correct" blockages, why does heart disease continue to be the leading cause of death and disability in the nation, despite millions of procedures performed each year at a cost of more than $65 billion? Why do heart attacks occur even after these blockages have been "fixed"? Why is it that many patients' symptoms and suffering — signals that the heart is not getting enough blood flow — persist or return soon after surgery? Why do 54 percent of angioplasty patients, 20 percent of stenting patients, and 8 percent of bypass surgery patients require repeat procedures within a few years? And how can we explain cardiac syndrome X, or microvascular angina, which causes a patient to have all the symptoms of heart disease but doesn't show any visible blockages on a catheterization?[2] All of these questions suggest there is more to heart disease than we thought. It cannot be a simple matter of distinct blockages in the major coronary arteries.

A NEW DEFINITION EMERGES

An overwhelming volume of research in recent years has provided clear evidence that heart disease is *not* a plumbing problem, defined by blockages in the arteries that bring blood to the heart. Instead, we now recognize that heart disease is a *chronic, system-wide* illness in which poorly functioning blood vessels weaken circulation, particularly in and around the heart. These blood vessels — most likely damaged by inflammation and autoimmune conditions, genetic predisposition, chronic infections, and lifestyle habits — create an atmosphere where blockages can develop and flourish. At its core, then, heart disease is not defined by blockages, but by their *underlying cause:* damaged blood vessels that inhibit blood flow.

As knowledge of the true nature of heart disease has emerged, so has the growing recognition of inflammation's role in a wide variety of conditions. Inflammation is a basic biological defense mechanism, and it has been found to be a major contributing factor in numerous debilitating conditions, including cancer, Alzheimer's disease, and arthritis. Heart disease is no exception, and several clin-

ical studies have identified inflammation as the primary suspect in the quest to unravel the origins of our most deadly disease. This epic moment in the history of heart disease shatters the conventional wisdom that blockages define the disease.

To illustrate this point, marking a monumental shift in our understanding of heart disease, the *New England Journal of Medicine* published a study in 2002 showing that the blood level of C-reactive protein (CRP), a substance that the liver releases in response to inflammation in the body, is a better heart attack predictor than cholesterol level.[3]

Even more recently, researchers identified a new inflammatory marker released specifically by blood vessel cells, called *placental growth factor* (PIGF). PIGF has also been linked to heart attack risk, again pointing to inflammation as a key factor in heart disease.[4]

There is increasing evidence that chronic infections, such as periodontal (gum) diseases, may play a role in the development of coronary artery disease. They are believed to do so by subjecting an individual to persistent, low-grade inflammation. There is also some evidence that the bacteria at the root of gum disease may in-

teract directly with blood vessels, causing changes to cholesterol molecules and the rupture of atherosclerotic plaques.[5] Gum disease is 38 percent more common in people with heart disease than in people without it. And the worse their dental disease, the more likely they are to have coronary artery disease.[6]

Evidence of the role that inflammation and other autoimmune factors play in heart disease continues to grow. In one large review study published in the *Journal of the American Medical Association*, researchers found that elevated levels of antibodies to *Chlamydia pneumoniae* (the common bacteria for walking pneumonia, bronchitis, and sinus infections) indicating exposure to infection, increased the risk of developing coronary artery disease and having a heart attack.[7] (A variation of this microbe is also responsible for a sexually transmitted disease.) There is emerging evidence that other infections, such as cytomegalovirus and *Helicobacter pylori,* increase the risk of coronary artery disease as well.[8] Other studies conclude that some antibiotics may slow the progression of atherosclerosis, further strengthening the link between inflammation and heart disease.[9]

This is a dramatic departure from the theories that have driven heart disease treatment and management for decades, and it signals the need for a complete shift in the way we think about and address the disease. In particular, this new research calls into question the usefulness of procedures that target individual blockages, and it offers a reason why so many problems often persist even after patients have undergone such operations. Instead of treating the *disease*, the procedures only treat a *byproduct*.

DIAGNOSING HEART DISEASE

As a result of the historical focus on blockages, heart disease is commonly diagnosed by identifying and quantifying the specific blockages in coronary arteries. For many patients, the diagnosis seems to come without warning. Their experience might go something like this: They tell their doctor they have not been feeling quite right lately, prompting their doctor to recommend a battery of tests, including a stress test. (A stress test may also be recommended as a routine screening tool.) The test identifies an abnormality, indicating that an area of the heart is not getting enough blood. To further diagnose

the cause of this abnormality, their doctor recommends a cardiac catheterization (also called an *angiography*). A catheterization is a diagnostic test during which a catheter (tube) is inserted into a peripheral artery (usually the femoral artery in the groin) and threaded first into the aorta and then into the major arteries feeding the heart. During the catheterization, dye is injected into the coronary arteries and X-ray pictures are taken to see whether any blockages are present. If blockages exist, their locations in specific arteries will be pinpointed, and their degree of obstruction quantified (e.g., 50 percent, 70 percent, or 90 percent). The patient is then handed their diagnosis. They have heart disease.

Cardiac Catheterizations

Cardiac catheterizations are widely performed in the United States, almost in epidemic proportions. In 2002, more than 1,463,000 cardiac catheterizations were performed at a cost of $23.3 billion. The test is not without risks, including bleeding, infection, and cardiac complications. There is also a 1 percent death rate from cardiac catheterizations gone

wrong.[10] In addition, it has been estimated that as many as 50 percent of cardiac catheterizations may be unnecessary or could at least be postponed.[11]

However, new noninvasive technology that can diagnose heart disease may make catheterizations a thing of the past. Ultrafast CT (computed tomography) scans use X-rays to visualize the coronary arteries in such detail that they are comparable to invasive catheterizations and can substitute for angiography.[12] An ultrafast CT scan identifies plaque in vessel walls, often before it begins to interrupt blood flow. The scan is simple to perform: The patient lies down on an exam table while passing through the "donut" of the scanner. About fifteen minutes later, the test is complete.

TAKING ACTION

One day, you seem to be fine. The next, your physician informs you that you have serious blockages and urges you to immediately undergo a "corrective" procedure, such as a coronary artery bypass graft oper-

ation (CABG, or bypass, for short), angioplasty (a procedure in which a balloon is inserted into a blockage and inflated to push the blockage out to the perimeter of the artery and allow blood to flow through the vessel), and/or placement of a stent (a scaffoldlike device inserted into a blockage in an artery to allow blood flow). According to the American Heart Association, more than 1.7 million invasive procedures are performed annually.[13] Specifically, 515,000 bypass operations (cost: $31.3 billion) and 1,204,000 angioplasties and stent placements (cost: $34.3 billion) are performed each year, and these numbers continue to rise.[14]

This diagnosis and turn of events is alarming to most people. The idea that there are blockages in the arteries bringing blood to your heart is scary, and many people want to believe that a "routine" procedure will "take care of" the blockages so they will not have to worry about them anymore. Patients often do not realize that blockages typically take years to develop, and in most cases, the situation is not an emergency. You are the same person you were thirty minutes earlier, before the catheterization took place. The only difference is that now you *know* about your

blockages. Still, with seemingly little time to think, many patients heed the advice of their doctors and undergo one of these recommended invasive procedures, often expecting they will be as good as new afterward.

But bypassing or opening specific blockages is like directing traffic at one intersection when the whole city is in gridlock: it may get some people moving, but it only offers a short-term fix that fails to address the fundamental problem. Just as it is only a matter of time before another traffic jam develops, if an individual blockage — rather than the core illness — is your target, it is only a matter of time before a new blockage will arise and cause difficulty. What about the rest of the diseased artery, which offered an environment for the blockage to develop and will likely do so again? What about the other blood vessels in the heart, which may house blockages soon, if not already? With this knowledge, it is easy to understand why so many heart disease patients become repeat cardiac customers and find themselves in a revolving door of procedure after procedure.

Your challenge and responsibility is to learn as much as you can about your dis-

ease and about all of the treatment options available to you. Only then will you be able to make an educated decision about how to proceed to achieve heart health. This book aims to be a source of information for you and your loved ones, with the hope that it will empower you to make truly informed decisions in your best interest.

SHATTERING THE MYTHS OF HEART DISEASE

Despite the tremendous volume of research that has redefined heart disease in recent years, patients and their loved ones are still walking around with a great deal of misinformation regarding the true nature of heart disease and the treatments available to address the core problem. This misinformation prevents people from making educated decisions about how to manage their disease. Four widely held myths must be dispelled if we are to treat heart disease successfully.

Myth #1: Heart disease is about blockages. Heart disease is a systemic, or system-wide, illness. Above all else, it is about impaired blood flow. It is not about blockages, and it is most likely not even confined to the heart arteries.

Myth #2: Procedures such as bypass

surgery, stents, and angioplasties are essential treatments and help eliminate heart disease. These procedures target individual blockages only, *not* the underlying disease. Though they temporarily improve blood flow to the heart, they simply place a Band-Aid on a symptom. The logical goal in treating heart disease is not just to bypass or open a particular blockage, but to maximize and normalize blood flow throughout the heart muscle and the entire body, on a systemic level. If blood can find alternate routes — around, in spite of, and beyond the blockages — to reach the areas of the heart that are not getting the necessary blood, the blockages become irrelevant, and so do the procedures aimed at opening or bypassing them.

Let me be clear: I am not suggesting there is never a need for invasive procedures. They are certainly necessary at times, and I openly embrace all forms of medical care that are supported by scientific research. Bypass surgery in particular is a groundbreaking procedure that has made an extraordinary contribution to the evolution of medicine. It has saved, and continues to save, thousands of lives around the globe. However, there are only two specific circumstances in which bypass

surgery has been shown in clinical studies to prolong life. The first is when the left main coronary artery is significantly blocked (greater than 70 percent). The second is when each of the three major coronary arteries has significant blockages and the heart muscle is weak. If the state of the disease does not fit either of these descriptions, there is no data to show that bypass surgery will offer long-term benefit, enhance survival, or prevent a heart attack.

The data for angioplasties and stents is even scarcer. There are *no* long-term outcome studies on either of these procedures; there is no evidence that they prolong life or will prevent a heart attack; and there are no head-to-head comparisons of angioplasties, plain stents, drug-coated stents, and bypass surgery to see which procedure is the best option in particular types of patients. There are also *no* long-term assessments of the impact on overall quality of life among patients who undergo these procedures.[15]

Some physicians recognize that many of these procedures are performed unnecessarily. "We are very aggressive when we think a patient needs angioplasty or bypass surgery," said Thomas Graboys, MD, associate clinical professor of medicine at Har-

vard Medical School. "But the vast majority of folks undergoing interventional procedures in the United States don't really need them."[16]

Despite the lack of scientific evidence to support their use, increasing numbers of these procedures are performed each year, and many heart disease sufferers continue to incorrectly believe their heart disease will be "taken care of" once they undergo one of these "quick, routine" surgeries. With this misconception as the basis of their decision-making process, they will inevitably be disappointed.

Myth #3: As soon as your heart disease is diagnosed, you must undergo an invasive procedure or operation immediately. If you don't, you might die. Heart disease progresses slowly, and blockages take many years to develop. Just because a diagnosis has been made and blockages have been identified does not mean operating on them is a dire emergency. In most cases, you have time to take a breath, educate yourself, weigh your options, and make a careful decision. One study, conducted at Harvard, provided a powerful illustration of this lack of urgency. Of eighty-eight patients who had been advised to undergo bypass surgery,

seventy-four (84 percent) received a second opinion contradicting that recommendation. Of them, sixty (68 percent of the total) chose to indefinitely delay the operation. None of the patients who opted against bypass died during the nearly two and a half years of follow-up. The study concluded that the number of surgical interventions could be reduced by as much as 50 percent among patients who receive a second opinion that removes the sense of urgency from their decision-making process.[17]

Myth #4: You'll be as good as new, with no need to worry about your heart disease, after a routine invasive procedure or operation. This is actually two myths in one. First, there is no such thing as a "routine" invasive procedure or operation. The risks of any operation are numerous, potentially serious, or even deadly.

Second, it is important to understand that heart disease is a chronic illness for which there is no cure. Nothing you do will make you "good as new." Heart disease is something you have to live with for the rest of your life. But you can live a rich, active life *with* the disease. You can keep symptoms at bay and slow the disease's

progression by making careful, educated treatment and lifestyle decisions.

If this information contradicts much of what you thought you knew about heart disease, rest assured you are not alone. But while it is challenging to dispel these widely held myths, doing so is critical to our success in battling the number-one killer.

REALIGNING PRACTICE WITH KNOWLEDGE

Our understanding of heart disease has completely transformed in recent years, so it is logical to expect that our treatment methods have transformed as well. Unfortunately, however, this has not been the case. While new scientific knowledge calls for a fundamental shift in medical practice, the same tragically outmoded techniques we have used for decades continue as the norm, and we have lost valuable time in our quest to rein in the number-one killer in our country.

Some doctors simply do not accept the irrefutable science that has redefined heart disease. Although they know the old "heart disease is about blockages" model no longer holds, they still base their practice on it and continue to open blocked arteries

anyway.[18] In a candid exposé in the March 21, 2004, *New York Times*, Dr. Eric Topol, an interventional cardiologist at the Cleveland Clinic, stated bluntly: "There is just this embedded belief that fixing an artery is a good thing."

In the same article, Dr. David Hillis, an interventional cardiologist at the University of Texas Southwestern Medical Center, offered a possible explanation for this mentality, suggesting business plays a significant role. "If you're an invasive cardiologist and Joe Smith, the local internist, is sending you patients, and . . . you tell them they don't need the procedure, pretty soon Joe Smith doesn't send patients anymore," he explained. "Sometimes you can talk yourself into doing it even though in your heart of hearts you don't think it's right."[19]

Dr. Hillis cited another possible explanation for the continued prevalence of artery-opening procedures: "I think it is ingrained in the American psyche that the worth of medical care is directly related to how aggressive it is." According to Dr. Hillis, a patient may come in to the doctor's office convinced that an invasive procedure is the right course of action. "Americans want a full-court press," Dr.

Hillis said, "I think they have talked to someone along the line who convinced them that this procedure will save their life. They are told, 'If you don't have it done, you are . . . a walking time bomb.' "

But whether it is a force of habit, a fear of losing patient referrals, or a patient's desire for aggressive techniques, the bottom line is that very little, if any, scientific evidence supports the widespread use of shotgun, site-specific, artery-opening procedures. Instead, Prediman K. Shah, MD, director of cardiology and director of the Atherosclerosis Research Center at Cedars-Sinai Medical Center in Los Angeles, has estimated that heart attack risk could be reduced by as much as 80 percent by using a comprehensive, noninvasive approach to treatment.[20] The *Times* article included this summation from Dr. David Waters of the University of California: "[Coronary artery disease] is a systemic disease. It occurs throughout all the coronary arteries. If you fix one segment, a year later it will be another segment that pops and gives you a heart attack, so systemic therapy . . . has the potential to do a lot more." But, he added, "There is a tradition in cardiology that doesn't want to hear that."[21]

Not only does traditional cardiology not want to hear it, but since most patients rely on their doctors to educate them about their disease, many heart disease sufferers do not get the information they need to make appropriate treatment decisions. The exciting findings about EECP — which could and should save patients the time, risk, and expense of invasive procedures — have not trickled down to the average heart disease sufferer. If they had, many patients would refuse to undergo surgeries that are essentially unnecessary and unhelpful, and the number of these procedures performed each year would drop, not rise as they currently do.

ENVISIONING THE PERFECT TREATMENT

Let us remember for a moment the overriding goal in treating heart disease. It is not to cure it — there is no cure. It is not to clear blockages — they are only manifestations of the disease. The goal is to help patients *live* with heart disease, as long and as well as possible. This means alleviating their symptoms, preventing complications such as heart attacks, and maximizing their quality of life.

As we have seen, the latest research

proves unequivocally that the most sound, effective heart disease treatment would take a systemic, rather than a localized, approach. It would counteract inflammation, strengthen the vascular system, and improve circulation throughout the body and, in particular, to the heart — *beyond the blockages.* It would enable the heart to receive and pump as much blood as it needs, and do so more effectively.

We have such a treatment at our fingertips, one that accomplishes all of these goals noninvasively, safely, and comfortably. It has been the best-kept secret in medicine. Until now.

Enhanced external counterpulsation (EECP) is a groundbreaking treatment that offers patients a ticket out of heart disease's all-too-common downward spiral. It is a noninvasive treatment that is accepted by mainstream medicine, FDA approved, Medicare approved, covered by insurance, and available throughout the United States and around the world.

My mission with *Heal Your Heart with EECP* is to help patients and their loved ones understand the true nature of their disease and empower them to make informed health-care decisions knowing all of their treatment options.

Heal Your Heart with EECP is not critical of conventional medicine. On the contrary, it relies on both historical perspective and a review of the latest scientific research to explain why the procedures traditionally used to address heart disease are often misguided, and to argue that medical practice at its best should allow science, not habit, to guide the way. With this new understanding, *Heal Your Heart with EECP* offers and celebrates a welcome solution. EECP is a revolutionary, proven, lifesaving treatment that makes it possible for patients to stop living with the pain of heart disease, stands to curtail billions of dollars in health-care costs, and truly "does no harm," in the words of the Hippocratic oath. For these exciting reasons, its rightful place is at the forefront of heart disease management.

I am the founder of Braverman EECP Heart Centers, the largest EECP practice in the United States and the only medical practice solely dedicated to the treatment. I have treated more than two thousand patients with EECP, and I am continually amazed by the monumental impact this simple, little-known treatment has on the health and quality of life of those who receive it. For five years, I have worked to

educate both physicians and patients throughout the Philadelphia area and around the world about EECP. I lecture extensively, appear regularly on television and radio, and provide interviews in newspapers and magazines. Still, the vast majority of heart disease sufferers and their families have never heard of EECP. That is why I have chosen to write this book.

Stories about some of my patients' remarkable experiences with EECP are sprinkled throughout this book. Their lives move and inspire me every day, and I am confident they will do the same for you.

Enjoy your journey as you learn about EECP, one of the most exciting medical innovations of the last fifty years. When you have finished, please pass this information on. For the sake of the millions of heart disease sufferers and all those who love them, join me in my effort to make EECP the household name it ought to be.

1

EECP IS A MODERN MARVEL

There Is No Cutting on the Cutting Edge

Imagine treating heart disease without surgery, drugs, pain, or risk. And imagine that the treatment was not only clinically proven and covered by Medicare and private insurers, but that it made patients less likely to require hospitalization and actually saved money in the long run. Next, imagine the treatment was comfortable and provided on an outpatient basis, so people could receive it during their lunch break, before work, on the way to the mall, or any time that was convenient for them. Then imagine the treatment was so safe and adaptable to so many body types and medical problems that it suited virtually every heart disease sufferer.

There is no need to keep imagining. The treatment exists. It is available right now,

all over the country and around the world. It is enhanced external counterpulsation (EECP), and it is changing the way people *live* with heart disease every day.

The news about EECP gets better and better. As the only treatment that works on a systemic level, it is the most logical treatment for heart disease. It is simple and noninvasive. Clinical research has proven — dozens of times over — that it is tremendously effective.

I am a physician because I want to make a real difference in the lives of individuals who are sick. When I first learned about EECP, it seemed too good to be true, and I insisted on doing extensive research before I would believe it. But everywhere I looked, I found only encouraging news — no skeletons in the closet whatsoever.

With EECP, I help people live better, fuller lives, without risk. I am constantly astounded by the benefits my patients receive from the treatment. The results sometimes border on miraculous, and they bring me enormous personal and professional satisfaction.

There is no catch, no fine print. In this chapter, I will explain what makes EECP a no-brainer and show you why it represents all that I love about being a physician.

MY JOURNEY TO EECP

My lifelong dream was to be a physician at an Ivy League medical center. Everything I did was with that goal in mind. I graduated from Cornell University Medical College (now known as the Weill Medical College of Cornell University), and I went on to become a resident at the New York Hospital–Cornell Medical Center (now known as the New York Presbyterian Hospital). I wrote and published several articles and was appointed chief resident, all the while keeping my sights on an academic career. When I completed my residency, I was appointed to a full-time position at the University of Pennsylvania School of Medicine as an assistant professor in the Department of Rehabilitation Medicine. My dream had come true.

I remember sitting in my new office on my first day, looking out the window at the campus's incredible architecture. I felt tremendous pride, and I felt at home. I loved teaching, caring for patients, writing articles, and conducting clinical research. I thought I was there to stay.

But three years later, I learned about EECP. I had never heard the acronym, let alone knew what it stood for. I assumed it

was a fad or gimmick, and with a skeptical eye, I began to do some research. The more I learned and read about EECP, the more enthralled I became. A treatment that has scores of clinical studies to back it up, carries no risk, and brings suffering, end-stage cardiac patients back to life? It seemed impossible. I had to see it for myself.

I flew to the West Coast to visit an EECP clinic. The treatment certainly got my attention; it was unlike anything I'd ever seen before. During EECP, blood pressure cuffs are wrapped around the patient's legs. The cuffs squeeze and release in sync with the patient's heartbeat, promoting blood flow throughout the body, particularly to the heart. The effects of this blood flow, I would soon learn, are astounding.

I met a ninety-seven-year-old man whose activities were so limited prior to starting EECP that he could barely care for himself. But only halfway through his EECP treatment program, he had thrown away his cane, and he was now walking without difficulty and enjoying life again. His transformation took my breath away. I also met a fifty-four-year-old woman with diabetes who had already undergone by-

pass surgery and several stent placements, but was still unable to climb a flight of steps without taking nitroglycerin to ease her chest pain. In her last week of EECP, she was walking two miles a day with no pain. With tears in her eyes, she told me, "EECP saved my life."

I met numerous patients that day, each with their own incredible story, and I was blown away. While I had read the studies on EECP, I did not understand the profound impact the treatment had on patients' lives before I spoke to them myself. EECP, I could clearly see, embodied the reason I became a physician in the first place: to enable the sick to live the life they desire.

As I flew back to Philadelphia, I made a decision I never had imagined for myself. I decided to leave my coveted position at the University of Pennsylvania and open my own practice, solely dedicated to EECP. Heart disease sufferers deserved to know this incredible treatment was available to them, and I was determined to do everything in my power to see that they did.

Word spread on campus, and my colleagues were convinced I was crazy. They warned me that most doctors who go into

private practice fail. But my mind was made up.

I started out with one small office. Five years later, I have five offices — the largest EECP practice in the country, and it's still growing. Each day, another patient tells me how EECP has changed their life, and I am reminded that I made the correct decision.

THE MARVEL OF EECP

Here is a look at what makes EECP such a remarkable and exciting treatment.

EECP Is Safe

Consider the magnitude of this statement. There are no exceptions, no caveats, no ifs or buts. Of the thousands of patients who have been treated with EECP, *not one* has died, suffered complications, or experienced any negative side effect as a result. With EECP, there is *no* risk to your heart, lungs, brain, or any other organ. The treatment cannot cause a heart attack — in fact, the FDA approves EECP as a treatment for use *during* a heart attack. It cannot cause a stroke, infection, cognitive impairment, or bleeding complication, all of which are common side effects of surgical and invasive heart disease treatments.

EECP's safety is an accepted and undis-

puted medical fact. In this way, EECP may very well be in a class by itself. Can you think of any other medical treatment, procedure, or drug that has *no* risks or side effects?

EECP Requires No Recovery Time

Because EECP is completely noninvasive and is provided as an outpatient treatment, patients schedule it like any other doctor's office visit. There is no pretreatment preparation, no period of convalescence or recovery time afterward, and no interruption of daily life. Many people come in for their treatment before work, on their lunch break, or at some other convenient time. When they are done with a session, they simply get off the EECP bed, put on their coat, and go on their way. Most patients go to work, go shopping, or participate in volunteer or other activities when they leave my office.

EECP Works

As we will review in more detail in chapter 3, more than a hundred articles and studies on EECP have been published in major medical journals. *All* of them document the treatment's staggeringly high rate of effectiveness in reducing or eliminating angina (chest pain, shortness of breath, fatigue, and

other symptoms) and nitroglycerin use. EECP enhances the ability to exercise and engage in physical activity, and it improves blood flow to the heart, stress test performance, psychological and emotional outlook, and overall quality of life. EECP can even transform the lives of patients whose heart disease is so advanced that they cannot eat or dress without severe symptoms, allowing them to return to activities they thought they had given up forever.

EECP's Benefits Last

Clinical studies have shown repeatedly that EECP's positive effects last for years. EECP establishes improved blood flow patterns to the heart, which allows patients to be more active, and their increased activity level sets them on an upward spiral. Perhaps even more exciting are EECP's preventative effects. Patients are less likely to have a heart attack or require hospitalization in the years following EECP than those who had surgery or no treatment at all.

The importance of these beneficial effects cannot be overstated. Once heart disease sufferers undergo their first bypass, stent, or angioplasty, many brace themselves for a seemingly endless stream of

additional invasive procedures. They are often told that it comes with the territory of having heart disease. But since these invasive procedures do not get to the heart of heart disease, it is understandable that they must constantly be repeated. EECP, on the other hand, provides lasting improvement to a person's circulation and strengthens the blood vessels throughout their body. In doing so, it places them on a healthier course for the future. EECP proves it is possible for a heart disease sufferer to break out of the vicious symptom-surgery-recovery-symptom-surgery cycle, and it gets them back to doing the things they love.

EECP Is Truly Noninvasive

I'm sure you have heard advertisements and read articles about new, cutting-edge treatments for heart disease that are "minimally" or "partially" invasive. But consider this: if something penetrates the body, whether it is a drug, a needle, a knife, or any other foreign object, it is invasive. And when a treatment is invasive, the chances that complications will arise skyrocket. EECP is the only truly noninvasive treatment for heart disease. It involves absolutely no drugs, no needles, no intravenous infu-

sions, no tubes, and no knives. Nothing violates the body. The entire procedure is external, which is partly why EECP is so utterly safe.

EECP Is Painless

When people visit my office and get their first look at an EECP treatment, they often laugh and tell me it looks unusual. Since patients lie on blood pressure cuffs that inflate and deflate in time to their heartbeat, they do appear to be bouncing up and down on the bed, even though they are not. Despite its appearance, the treatment actually feels as if you were lying on a balloon that lifts and lowers your body in a very controlled motion.

EECP is so comfortable that many of my patients fall asleep during the treatment, snoring and all. There are no pinching or painful sensations. They feel nothing in their heart or chest. One patient remarked that it felt as if six massage therapists were simultaneously providing a deep muscle massage to their legs. If they don't fall asleep, many patients read, listen to music, or chat during the treatment. Afterward, they typically feel invigorated, even euphoric, as if they had just completed a stimulating workout while resting

at the same time.

I know from experience how EECP feels. I personally train all of the therapists who work in my practice, so while I do not have heart disease, I have received many treatments. By periodically hopping on the bed at each of my offices and being treated by my staff members, I can continually ensure that they are doing a great job. At the same time, I get the added benefit of all of that blood flow!

EECP Is Covered by Medicare and Private Insurers

EECP is accessible to the people who need it. Based on the enormous body of clinical evidence demonstrating that EECP is effective, Medicare began paying for the treatment in July 1999. In the months following Medicare's announcement, private insurers across the country established their own policies making EECP available to their members.

EECP Is Inexpensive and Saves Money in the Long Run

Since EECP is covered by Medicare and private insurance carriers, there are no out-of-pocket expenses for insured patients who receive the treatment. But since heart

disease sufferers are keenly aware of how expensive their medical treatments can be, it is interesting to compare the cost of EECP to that of invasive heart procedures.

EECP is dramatically less expensive than bypass surgery, angioplasty, and stents. In addition, by making patients less likely to have a heart attack or be hospitalized, EECP actually saves insurers money over time. It creates a win-win situation for patients and insurers alike.

Up-front costs. A full course of EECP costs insurers approximately $6,000. This is in sharp contrast to bypass surgery, angioplasties, and stents, which can cost anywhere from $20,000 to $100,000 or even more.

For example, if you went to an emergency room complaining of chest discomfort or difficulty breathing, it would be necessary to determine the source of the problem. Multiple physicians would evaluate you, give you medications, run tests, do blood work, and perform procedures. Even if they concluded you were simply having indigestion and sent you home, your visit to the emergency room, without being admitted to the hospital, would cost about the same as an entire course of EECP.

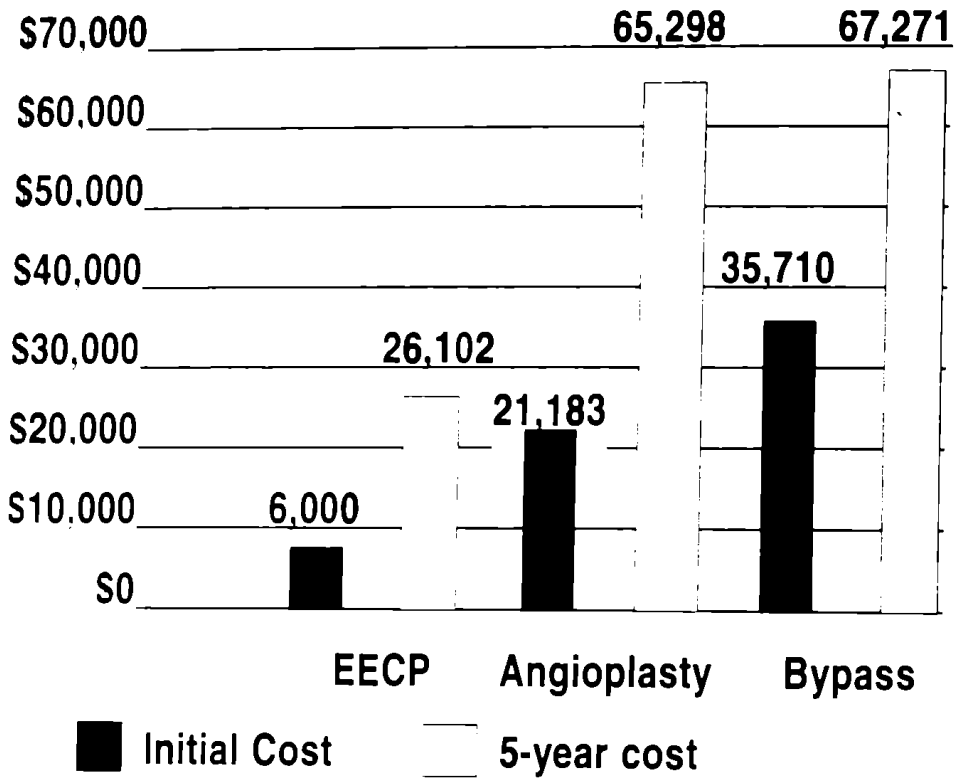


Figure 1. Long-term health-care costs for patients who receive EECP, angioplasty, and bypass.

Long-term savings. Being noninvasive and performed in an outpatient setting, it is no surprise that EECP is by far the least expensive clinically proven treatment for heart disease. What continues to shock the medical community, however, is the long-term cost savings for patients treated with EECP compared to those who undergo bypass surgery or angioplasty. If you tally all of the costs associated with caring for heart disease sufferers (hospital visits, procedures, tests, medications, and so on)

for the five years after they received EECP treatments and compare it with the cost of care during the same time period for patients who underwent bypass surgery or angioplasty, you will find that the EECP patients are far less costly to treat. During the five years following their treatment, EECP patients typically generate approximately $26,000 in heart-related health-care expenses, while bypass and angioplasty patients have closer to $65,000 to $70,000 in expenses.[1] More than $66 billion is currently spent each year on heart disease treatments.[2] That cost could be reduced by as much as two-thirds if EECP was used on a wider scale.

The most important point, of course, is that EECP patients feel better, which creates immeasurable economic ripple effects. They are more likely to stay away from the doctor and live an enriched quality of life. And the effects extend far beyond the health-care system. The better patients feel, the more they enjoy life and remain productive. They are more willing and able to work, shop, vacation, and participate in everything life has to offer, without the symptoms, limitations, and fears that often dominate the lives of heart disease sufferers and their loved ones.

Imagine returning to the economy even a percentage of the $71.4 billion lost annually due to reduced productivity caused by heart disease.[3]

EECP Is Right for Almost Anyone

My practice has treated more than two thousand patients with EECP, and our vast, diverse experience leads to our high success rate. Our patients have ranged in age from thirty-six to ninety-seven. They have weighed as little as 82 pounds and as much as 489 pounds. While the treatment is relatively simple, each person is different, with a unique size, shape, and list of medical issues. Some medical conditions require special attention while a patient undergoes EECP. For these reasons, the treatment must be individualized. Before treating any patient, I review their medical records, speak with them at length, and perform a thorough physical exam to identify any special circumstances or precautions that must be taken during their treatment. I have successfully treated amputees; cancer survivors; oxygen-dependent and dialysis patients; heart and kidney transplant recipients; patients with osteoporosis, colostomies, hernias, hip and/or knee replacements, insulin pumps, and severe cognitive

deficits; patients who have had neck or spine surgery; and more. I even treated a patient with a cast on her leg, and she experienced amazing results. By being creative, personalizing the program, and recognizing that a patient's comfort is critical to their success, we can make the treatment work for just about anyone.

Case Study

In the last year, Pamela S., age forty-seven, suffered three heart attacks. Despite having two stents placed, she continued to have angina daily with most activities. She also had a nonhealing ulcer on the bottom of her right foot (a complication of poor leg circulation and insulin-dependent diabetes). Finally, her cardiologist sent her for EECP. After six EECP treatments, a cast was placed on her leg to aid in healing the wound — a process she had been through many times over the years for various ulcers. We were able to work around the cast and continue her EECP treatments uninterrupted. After her twenty-sixth treatment, the cast was removed. Her podiatrist

was stunned at how quickly and thoroughly the ulcer had healed this time, saying, "The blood flow from EECP made all the difference!" By the end of her course of EECP, Pamela was having angina only once a week and could engage in more physical activities without limitations.

EECP Is Good for the Soul

When you feel better physically, you feel better emotionally and psychologically. Several clinical studies have documented the quality of life and emotional improvements that result from EECP's physical benefits. I often marvel at the way many of my patients become giddy as they begin to feel the treatment's effects. With the boost in blood flow to their heart and throughout their body, they are simply overjoyed to be reminded how feeling good feels!

EECP Does the Seemingly Impossible

With EECP, patients can sleep and exercise at the same time. It sounds silly, but that is precisely what is happening. EECP is passive exercise. As the blood pressure cuffs squeeze and release in time to a patient's

heartbeat, they stimulate the patient's circulation for them. By enhancing blood flow, EECP provides the same benefits as endurance training, stimulating blood vessels throughout the body so they grow, become stronger, and become better able to deliver more blood, oxygen, and nutrients to the body's cells and organs. This is especially good news for heart disease sufferers who are often so limited by their symptoms that they cannot perform even the most basic tasks — walking, climbing steps, carrying groceries — let alone exercise vigorously enough to achieve long-term benefit. EECP gives them the benefit of exercise despite their limitations; it is exercise for those who cannot exercise. And not only does a patient get the circulatory benefits of exercise while resting, they are able to do so comfortably, noninvasively, and without checking in to the hospital.

There Is No Downside to EECP

You may be thinking, as I once did, that EECP sounds too good to be true. But it is that good. There is no significant downside to the treatment. The most common complaint my patients have is not finding a good parking space at our office buildings! Some patients anticipate a problem with the time

commitment that a daily treatment regimen will require. However, once they begin their program — and start to feel the incredible, sometimes immediate, benefits — they find it isn't hard at all to keep to the schedule. Most even look forward to it: fewer than 5 percent of my patients drop out of the program.

Case Study

Madeline G., age seventy-four, suffered from congestive heart failure, hypertension, and diabetes. She had suffered a silent heart attack and a series of ministrokes. She was diagnosed with heart disease twenty-five years ago and refused to have bypass surgery, angioplasties, or stents, relying only on medication to manage her illness. She had been doing well until she reached age seventy, when she realized she was having more and more angina with less and less activity. She suffered almost daily chest pain, shortness of breath, and fatigue, especially when she walked, talked on the telephone, or exerted herself. "I wasn't able to do much of anything," she

said. She had become dependent on friends and neighbors to do her household chores and run her errands. She heard about EECP on the radio and thought, "This is exactly what I have been waiting for." After EECP, Madeline's energy increased dramatically, her angina disappeared, and she stopped using nitroglycerin for the first time in twenty-five years. She was independent again, could do things for herself, and was able to be more social. She returned to using public transportation to visit her friends and family. "I feel like a new person! I have no chest pains," Madeline said. "I thank God I came!"

Some patients may occasionally experience skin irritation on their legs from the cuffs' squeezing action. In my practice, we help patients avoid this by providing tight-fitting Lycra exercise pants for them to wear during their treatment. The pants do not buckle or bunch up under the cuffs, so they eliminate friction on a person's legs. If a patient has particularly sensitive skin or a high risk of skin irritation (for ex-

ample, from diabetes, neuropathy, or peripheral vascular disease), I recommend that they moisturize daily and wear nylon pantyhose beneath their exercise pants to provide another layer of protection. A well-trained EECP therapist helps patients avoid skin problems by assessing their needs daily, wrapping the cuffs properly, and using extra padding (such as foam, sheepskin, or rubber) where needed.

While some patients with a history of low back pain may experience a flare-up at the start of their treatment, many see their back pain actually improve as a result of EECP. The improved blood flow to the spine and surrounding tissue provides nutrients and oxygen and washes away the metabolic waste products and chemicals that stimulate nerves to transmit pain signals. Again, a skilled EECP therapist is trained to prevent any difficulties and will address them immediately if they should arise.

COMMON QUESTIONS

Many heart disease sufferers have special concerns about whether they would be good candidates for EECP. Individuals who have pacemakers or irregular heartbeats, for example, often ask whether they can still receive the treatment. Likewise, patients who

have recently undergone invasive cardiac procedures, who have had blood clots in their legs, who take Coumadin, or who suffer from peripheral vascular disease routinely inquire about whether their particular situation is suited to EECP. In all of these circumstances, there is good news. Because EECP is safe and noninvasive, it is appropriate for nearly all heart disease sufferers. In this section, we will review what makes EECP a successful treatment approach in each of these special cases.

Pacemakers, Internal Defibrillators, and Irregular Heartbeats

I have treated hundreds of patients with these devices and rhythm disturbances without any difficulty and with excellent clinical results. There is no risk that a pacemaker or defibrillator will malfunction due to EECP, and the treatment cannot cause abnormalities in someone's heart rhythm. Patients with cardiac pacemakers and defibrillators can expect to enjoy the same reduction in symptoms and improvement in quality of life as those without pacemakers.[4] Similarly, an irregular heartbeat does not interfere with EECP. For example, the treatment is just as effective with patients who have a rate-controlled atrial fibrillation (50

to 100 beats per minute) as it is with patients who have a regular beat.[5] Each person's unique heartbeat makes the machine operate and triggers the cuffs to squeeze and release. So the blood pressure cuffs will squeeze a patient's legs in an irregular fashion if they have an irregular heartbeat, in direct response to their heartbeat. In every other way they get the same treatment and the same excellent results as those with a regular heartbeat.

Case Study

Mary S., age sixty-six, had congestive heart failure and a pacemaker, and she had suffered several heart attacks. She never had surgery because her blockages were inaccessible. Before EECP, Mary was oxygen dependent, and she was on a heart transplant waiting list. Most activities, particularly walking and climbing steps, triggered angina. She could not walk half a block without having to stop and rest. After EECP, she was taken off the heart transplant list, was no longer oxygen dependent, and could walk eleven blocks and climb steps with ease!

Invasive Heart Procedures

A recent cardiac catheterization, angioplasty, and/or stent placement does not preclude having EECP, and these procedures do not create any additional risk. Patients can start EECP as quickly as one week after undergoing one of these groin procedures. The only reason to delay EECP treatment is if there is any tenderness or swelling in the groin. The cuff that we wrap around the upper thigh goes all the way to the groin, so if the area is still very sensitive, the wrap will be uncomfortable.

The decision about how quickly to proceed with EECP after bypass surgery is based on the patient's overall recovery from the operation and their general medical condition. At a minimum, if a vein was taken from a leg to use as a bypass graft, the incision must heal before the EECP cuffs can be wrapped comfortably. I have treated patients as soon as two months following bypass surgery without difficulty.

Leg Blood Clots

Patients with extensive blood clot histories (deep vein thrombosis, or DVT) may receive EECP without difficulty, pain, or complication. I have even treated patients with a Greenfield filter (a filter placed in the

aorta of an individual who has a history of significant blood clots in their legs to prevent any future clots from traveling to the lungs) successfully and without complication. EECP cannot *cause* a blood clot. It actually has the opposite effect. When blood does not flow, when it is stagnant, it may begin to coagulate and clot. But EECP creates more blood flow in the legs than a patient may have had in years. It makes blood clots less likely to form.

If a patient has a history of blood clots, if they are unsure, or if they are concerned for any reason, I send them for an ultrasound of their legs prior to starting EECP to confirm that everything is clear. However, if a patient *currently* has a blood clot in one of the deep veins in their leg, I delay starting EECP until the clot resolves.

Coumadin or Other Blood Thinners

There is no trauma involved in EECP, and individuals on Coumadin, Plavix, aspirin, or any other blood thinner may undergo EECP safely and successfully, without risk of bleeding or bruising. The cuffs apply equal pressure around the circumference of the legs, so it would be more traumatic if someone poked you really hard with their finger than if you received EECP. We

monitor Coumadin blood levels carefully, and we try to keep patients' international normalized ratio (INR) level to a maximum of 3.0 to 3.5. Even patients on Heparin who are fully anticoagulated (that is, the drug prevents their blood from clotting) have been treated at EECP centers around the country without any difficulty. I have also successfully treated patients with chronically low platelet counts (as low as 20,000, placing them at high risk of bleeding and bruising) without complication.

Peripheral Vascular Disease

Patients with peripheral vascular disease (PVD) resulting in poor leg circulation do quite well with EECP, although it may take them a bit longer to see a result. Poor leg circulation means that there is less blood in the legs for the EECP cuffs to pump back up toward the heart. To address this problem, patients with significant PVD often require more than the standard thirty-five EECP treatments to achieve a benefit. We routinely offer at least fifty treatments to these individuals to achieve optimal clinical results. The initial treatments improve blood flow in the legs, while subsequent treatments provide an opportunity for the increased volume of blood in the

legs to improve blood flow to the heart and the rest of the body. In my practice, even amputees and patients who have had bypass procedures on their legs have seen excellent results from EECP. Not only do their heart disease symptoms improve, the symptoms associated with poor blood flow in their legs — coldness, numbness, tingling, cramping, and fatigue — improve significantly as well, which often has an even greater impact on their quality of life.

Case Study

William A., age seventy-five, had a quintuple bypass at age sixty-five, followed by two different angioplasty/stent procedures (at age seventy-one and age seventy-four). He had also suffered a stroke and had hypertension and diabetes. William suffered from severe peripheral vascular disease, had had multiple bypass surgeries on his legs, and had undergone a partial amputation of his left foot. Before EECP, William experienced "crushing" chest pain and shortness of breath with basic activities and walking. His cardiologist referred him for EECP. After two

weeks of EECP treatments, he went for a routine checkup with his podiatrist, who said: "I feel pulses in your feet for the first time in years! Am I crazy?" William answered, "No; it's just EECP." By the end of his treatments, the severity and frequency of his angina had dramatically decreased. His energy level increased substantially, to the point that he was able to walk with his wife for twenty-five minutes daily without having to rest. He was back on the social scene — going shopping, dining out, and playing cards with his friends. "I didn't know I could feel this good," William reported.

However, patients who have leg pain at rest (while sitting or lying down) or gangrene will not likely improve with EECP. Circulation in these individuals is so compromised that it is probably too late for EECP. But receiving EECP before the disease advances to that point will likely help the patient.

Clinical trials are currently underway to study the effect of EECP on patients with PVD and to formally document the bene-

fits that I, and many other leading EECP providers around the country, observe every day. I am confident the research findings will eventually lead to insurance coverage for EECP as a treatment specifically for PVD.

WHO SHOULD NOT HAVE EECP

Very few conditions preclude a patient from receiving EECP, and many of these conditions are temporary or can be addressed to allow for EECP at a later date. Here is the brief list.

Fever. A fever is an indication that the patient's body is fighting an active infection, and it is very likely that they have bacteria or viral particles circulating in their bloodstream. The increased blood flow that results from exercise and from EECP could promote "seeding" of the infection in the heart, causing damage. So, just as someone should not exercise if they have a fever, they should not receive EECP until their temperature returns to normal.

Open wound. If a patient has an open wound on one of their legs (where the EECP cuffs are applied), we would delay the treatment until the skin heals. However, nonhealing ulcers on the feet, as often experienced by diabetic patients or

those who have severe peripheral vascular disease, do *not* interfere with EECP. The treatment improves blood flow in the legs, which helps to stimulate the wound-healing process.

Severe aortic insufficiency. This condition is rare and can be diagnosed using an echocardiogram, a noninvasive ultrasound of the heart. Patients with a leaky aortic valve so severe that it requires surgical repair should not have EECP, as increasing blood flow back to the heart during its resting phase (between beats, or diastole) may worsen this condition. However, after the valve is surgically repaired or replaced, a patient may receive EECP without difficulty. Patients with other valve disorders (for example, mitral valve prolapse, tight or stenotic valve, or leaky mitral, tricuspid, or pulmonic valve) are routinely treated, safely and effectively, with EECP. While the valve condition itself will not improve, blood flow to the heart muscle will alleviate symptoms related to poor circulation.

Abdominal aortic aneurysm. Individuals with large (5.0 cm or greater) abdominal aortic aneurysms who have been encouraged to undergo surgical repair should delay EECP treatment until after

surgery. Again, this is a rare condition, and an abdominal ultrasound can determine whether or not a patient has an abdominal aortic aneurysm. For those who have already undergone abdominal aortic aneurysm repair, I often recommend that a diagnostic test such as a CT angiogram be performed prior to starting EECP to ensure that the repair is intact and that there are no microscopic leaks. I have treated many patients with abdominal aortic aneurysms smaller than 5.0 cm in diameter, as well as many patients after surgical repair, all with excellent results and no complications.

Superficial phlebitis. Superficial phlebitis is inflammation of the veins in the legs. EECP will be more comfortable if patients with active phlebitis delay treatment until the inflammation resolves.

Uncontrolled high blood pressure. Individuals with uncontrolled hypertension (greater than 180/110 mmHg) may not receive EECP treatment until their blood pressure is normalized.

Hemophilia. Individuals with rare severe bleeding disorders such as hemophilia should not receive EECP.

Pregnancy. A pregnant woman should not receive EECP, since scientists are not

sure what the effect of increasing blood flow to the fetus via the placenta would be.

IT'S A NO-BRAINER

When heart disease sufferers learn about EECP's incredible advantages (and realize there is absolutely no downside), they all say the same thing: "It's a no-brainer!" Most wish they had heard about it sooner. As one of my patients recently said, "You have nothing to lose, but everything to gain."

As the *only* safe, noninvasive, proven treatment for heart disease, EECP is truly in a class by itself. Since it is appropriate for nearly every heart disease sufferer — regardless of their age, size, or other medical conditions — and is covered by insurance, EECP is changing lives for the better every day, and it is doing so painlessly and inexpensively. In the next chapter, we will discuss exactly how EECP strengthens the most fundamental element of good health.

2

HEART HEALTH 101

It All Comes Down to Blood Flow

As we now know, heart disease comes down to an issue of poor blood flow. Rather than being defined by blockages, heart disease is a system-wide illness that impairs blood flow throughout the body — particularly to the heart. This was a seemingly inevitable discovery, because when we pinpoint the most fundamental element of health, we find agreement among all cultures, across the globe and throughout time. It is blood flow. In this chapter we will look at the common thread that connects nearly all schools of medical thought, and we will gain an appreciation for what makes blood flow so basic to a healthy body. Then we will examine how EECP supports the body's essential function and how it works — inside and out.

FLOW: A CONCEPT FOR THE AGES

For thousands of years, the idea of "flow" has been revered and recognized as central to life. It is a common denominator of most medical philosophies, treatments, and doctrines around the world. This is not a coincidence, but rather an affirmation of its importance. Virtually every student of medicine, regardless of the language they spoke, the era in which they lived, or the approach they took to healing, has recognized that flow *is* health.

Traditional Chinese medicine. A central tenet of traditional Chinese medicine is the flow of a life force known as chi (pronounced "chee"). The belief is that chi is present in all living things and circulates throughout the body. Blood is essentially the tangible form of chi: the two concepts are inseparable. Traditional Chinese medicine teaches that illness, pain, and organ dysfunction result from stagnation of energy, blood, and body fluid. Health, on the other hand, results from free and unobstructed flow. In Western medicine, the principle is the same. Blood cannot be separated from life. Healthy blood flow is essential to healthy life.

Ayurvedic medicine. India's five-thousand-year-old system of traditional medicine is another example of a medical paradigm centering on flow. According to Ayurvedic thought, every person's health and well-being is determined by a delicate balance of energy. Yoga, probably the best-known component of Ayurvedic medicine, combines carefully timed breath and movement to drive the flow of prana (life energy, similar to chi), and enables it to flow freely throughout the body. When pranic flow is strong, the body functions more effectively — from the digestion of food to the prevention of disease, and from the healing of ailments to increased clarity of mind. Yoga's movements are also rooted in the idea of flow, where the breath leads the body in moving fluidly from one pose to another. And while many people think of yoga simply as gentle movement or stretching, each sequence of poses is carefully crafted to raise the heart rate, thus stimulating blood flow. Once again, we see that blood flow, energy flow, and life force are inextricable concepts.

Ancient Egyptian medicine. Ancient Egyptian anatomy and physiology texts illustrated the job of the heart and blood vessels. The heart was revered as the

center of the body's functions, and it was believed to be the meeting point of the important vessels that carried all of the body's fluids, including blood, tears, urine, and sperm. The free flow of all fluids was recognized as essential for health and well-being.

Ancient Greek medicine. Hippocrates (ca 460–ca 377 BCE), considered the father of Western medicine, saw the body as governed by four corresponding "humors" (blood, phlegm, yellow bile, and black bile), just as the Greek universe was ordered according to the principles of four dynamic elements (fire, water, air, and earth). Blood was considered to be the dominant humor. According to Hippocrates's paradigm, all health and disease states were explained by humoral balance, imbalance, and flow or lack thereof. His *Theory of the Four Humors* provided the basis for medical thought for more than two millennia, until the time of the American Revolution. Galen, who lived five centuries after Hippocrates, crystallized the best work of Greek medicine. According to Galenic physiology, *pneuma* (air or breath, similar to chi or prana) was the fundamental life force. *Pneuma* was responsible, among other

things, for regulating blood flow and body temperature.

Blood flow is the most fundamental element of good health. It is the source of life. Cells are the building blocks in our bodies. A group of cells makes an organ, organs make a system, and systems combine to make the body: a complex machine, driven by the most powerful known pump — the heart. In a lifetime, the heart never stops to rest because its job — to keep blood flowing — is too important.

There is no replacement for blood flow. It is essential for the entire body to function. Blood, the body's most abundant fluid aside from water, has the vital job of carrying oxygen and nutrients to each and every cell in your body, giving them what they need to be healthy, and then carrying away waste products. If blood does not bring oxygen and nutrients to cells, and therefore fails to carry away cells' toxic waste products, disease will result.

It is not a coincidence that so many cultures, philosophies, and medical practices have historically recognized the fundamental importance of blood flow. It is also not a coincidence that people feel alive and alert when their blood is pumping. The

more active you are, the more your heart pumps, the more blood flows, and the better you feel. Conversely, the less active you are, the less your heart pumps, the less blood flows, and the worse you feel. It is literally that basic. We now know that the underlying cause of the most common diseases and conditions — heart disease; stroke; pain, arthritis, and joint disease; peripheral vascular disease; and premature aging, just to name a few — is lack of blood flow. Poor blood flow leads to the death of cells, tissues, organs, systems, and ultimately, the body. While this process naturally occurs throughout a lifetime, there is no need to despair. By improving blood flow and strengthening the body's ability to pump blood on its own, we maximize health and wellness, help the body heal itself, and prolong life. The more you do every day, the more you *can* do every day. And the less you do, the less you are able to do. This is a fact we all must accept, particularly as we age.

THE ANATOMY OF HEART DISEASE

The heart beats continuously, an average of eighty times per minute. It adjusts and responds, shifting the quantity of blood flow to the areas of the body that need it most: to a runner's legs, to an engineer's brain, or to your stomach after a meal. The heart also varies the number of times per minute that it beats since you certainly need more oxygen to run up two flights of stairs than to watch TV!

In coronary artery disease, a number of factors can impair blood flow to the heart. Arteries are blood vessels that carry oxygen-rich blood to all of the tissues in the body, including the heart. Healthy arteries — including coronary arteries (those that feed the heart) — are clean, smooth, and slick. The artery walls are dynamic, flexible, and able to expand to let more or less blood through when necessary. Heart disease is thought to begin with damage, such as cracks, to the linings of the artery walls. This injury makes arteries stiffer and more susceptible to the slow, progressive buildup of plaque deposits. These fatty deposits on the arteries' inner walls, called *atherosclerosis,* develop from cholesterol,

cellular waste products, calcium, and other substances in the blood. Plaque buildup often progresses very slowly over many years, causing blood vessels to narrow (stenosis), harden, and develop blockages. When this buildup affects the coronary arteries, it is called *coronary artery disease* (CAD). When coronary artery disease affects the heart muscle, it is called *coronary heart disease* (CHD). Here, we use the term "heart disease" to refer to both coronary artery disease and coronary heart disease.

The stenosis may be at a specific site, or it may spread out along the length of the blood vessel. In either case, the stenosis can reduce coronary blood flow. Diseased coronary vessels are more susceptible to periodic constriction (vasospasm), which can lead to temporary, stress-induced restriction of coronary blood flow both at rest and during activity. Finally, the formation of a blood clot (thrombus), particularly at the site of a ruptured blockage (atherosclerotic plaque), can partially or completely block a coronary vessel, causing unstable angina or a heart attack (myocardial infarction).

In short, in patients who have heart dis-

ease, the blood vessels that feed the heart are narrowed and may eventually become blocked, allowing less and less blood to reach the heart. If the heart does not get the blood and oxygen it needs, it cannot perform its job properly, and it cries out to the body: "I need more oxygen! I am not getting enough blood!" This cry comes in the form of angina. Or it may be more devastating: a heart attack.

Angina: More Than Just Chest Pain

The heart's persistent cry for help is called *angina,* and while many people think the term is interchangeable with crushing chest pain, it can take many forms. Signals that the heart needs more blood are different in everyone.

The Symptoms of Poor Blood Flow

The heart has many — including some quite unexpected and seemingly illogical — ways to communicate that it is not getting the blood and oxygen it needs. Angina is actually a collection of symptoms. Any or all of them may occur in a heart disease sufferer, depending on their partic-

ular body. A patient, for example, might experience shortness of breath, fatigue, a feeling similar to indigestion, or discomfort in the throat, jaw, teeth, ears, neck, upper back, shoulder blades, or arms. They might perspire, feel nauseous, or vomit. Any of these symptoms may signal inadequate blood flow to the heart.

An estimated 6.8 million people in the United States suffer from angina.[1] This is likely a gross underestimation because oftentimes patients and their doctors miss the diagnosis. Since so many patients think severe chest pain is the only sign of heart disease, they don't get the message when their heart cries out in a different way and do not realize there is trouble to report to their physician. Doctors, on the other hand, often fail to ask their patients the few key questions that would allow them to properly diagnose angina.

Instead of crushing chest pain, millions of people experience their angina as a vague "sensation," pressure, or tightness in the chest. It might even be fairly mild in severity. They often tell me: "It's not *pain*. It really doesn't feel that bad." But chest

pain does not have to be severe to be serious. And many people with heart disease never experience chest pain at all.

The diagnosis of angina — and therefore of heart disease — is frequently overlooked in women. Fewer than 30 percent of women with heart disease experience chest pain, the symptom most physicians look for in making an initial diagnosis. The most common heart disease symptom among women is fatigue (71 percent), followed by sleep disturbance (48 percent), shortness of breath (42 percent), indigestion (39 percent), and anxiety (35 percent).[2]

All these symptoms come under the broad category of angina. They all result from the lack of blood flow, and subsequent lack of oxygen, to the heart, which is the hallmark of heart disease.

Patients who experience their angina as fatigue or shortness of breath may get to know which activities will tire them out too much, and either completely refrain from doing them or carefully pace themselves during the day to avoid difficulty. They may not even realize they are making adjustments to their daily schedules, much less connect it to their heart disease. I often meet people who tell me they rest

for an hour or two after dinner in order to digest their food. Only after enough time has passed do they go ahead and take out the trash or clean up the kitchen. They know they might get angina if they try to do an activity right after eating, and with good reason. Remember, heart disease sufferers already have impaired blood flow to the heart. When blood is stolen to fuel the digestive process, even less blood is available to feed the heart.

You might lead a sedentary life and have no symptoms. But once you get off the sofa to do something, you have difficulty. Or you might take a nitroglycerin tablet before engaging in an activity to avoid getting into trouble, using the nitro as a preemptive strike against angina. These adjustments are important to recognize. They are signs that you are changing your habits to accommodate your heart disease. But modifying or curbing what you do in order to prevent angina *is* how angina may manifest for you.

Learning to recognize how angina presents itself in your body is the critical first step in managing your heart disease. Doing so can help you gauge the progression of your disease, give you a chance to seek treatment early on, improve your quality of

life in terms of your ability to do the activities you enjoy without limitation, and possibly even prevent a heart attack.

It's Not Just about Age

Many people attribute the pain or discomfort of heart disease to something else. I often hear: "I'm just getting old," "I'm just worn-out," or "I'm out of shape." While these statements may be true, it is more often the case that these individuals become easily tired or winded because their heart is not getting the blood and oxygen it needs. In other words, it is their heart disease — not their age or fitness level — talking.

Heart Attack: Sudden, Complete Blockage

Remember, blood flow is the body's fundamental source of health and life. When there is a sudden, complete blockage of an artery that supplies blood to an organ or tissue and there is no alternate route for blood flow, that organ or tissue is in danger and will often die. It occurs in the brain as a stroke, in the intestine as severe abdominal pain and possible bleeding, in the eye as

sudden blindness, in the kidney as pain and the inability to create urine, in the foot as gangrene, and anywhere else in the body where blood vessels are affected.

A heart attack, or myocardial infarction, occurs when there is a sudden, complete blockage of a coronary artery. If blood cannot use an alternate route to reach the portion of the heart that the blocked artery feeds, that piece of the heart is cut off from its blood supply and may become injured or die. If blood flow is restored within minutes, heart function may be impaired for twenty-four to forty-eight hours, but recovery would be expected. However, a total blockage that persists for more than twenty minutes makes it likely that the heart will be permanently damaged and its function as the body's circulatory pump will be permanently impaired. The ramifications of such an event are serious and may even be deadly, as the heart does not have the ability to regenerate. If a piece of the heart dies, it cannot be replaced.

For decades, our understanding of the natural progression of coronary artery disease was that atherosclerotic plaques grew larger and larger until they eventually blocked an artery completely and caused a heart attack. As a result of this perception,

coronary arteries that are more than 70 percent blocked are the ones typically targeted for bypass surgery, angioplasty, or stent placements. However, the last decade has brought a radically different understanding of how heart attacks occur. We now know that gradual plaque buildup is not the culprit. Instead, heart attacks are usually caused when a piece of inflamed, fatty plaque suddenly erupts from within the blood vessel wall, much like a volcano, and bleeds. The bleeding creates a blood clot that becomes lodged in the artery.[3] So it is not plaque, but a sudden blood clot that blocks the blood vessel and causes a heart attack. In addition, the plaques at the greatest risk of rupturing in this way are the smaller ones, which create artery blockages of less than 50 percent, not the larger ones targeted by surgical methods.

For a variety of reasons, it is not possible to surgically bypass, stent, or perform angioplasty on all of the smaller blockages. First, many of these vulnerable obstructions are too small to be identified on cardiac catheterizations. Second, when an artery is less than 70 percent blocked, ample blood may still flow through that vessel. Therefore, if such a blockage was located and surgically bypassed, the bypass

graft would not be utilized and would eventually scar and close. This enormous shift in our understanding of how heart attacks occur reinforces the dire need for a system-wide approach to treating heart disease.

In the last thirty years, public awareness of certain warning signs of a heart attack has grown considerably. But we still have a long way to go. You probably know that if you have severe chest pain, perhaps accompanied by pain that travels down your left arm, it is a serious matter and might indicate that you are having a heart attack. But as we saw earlier, many people with heart disease never experience chest pain. Just as angina takes many forms, ranging from subtle to debilitating, the signs of a heart attack vary tremendously from patient to patient. Some individuals may feel dizzy, nauseous, or particularly tired, or they may experience a variety of other symptoms during a heart attack. Other people may feel nothing at all. These are the patients who find out later, much to their surprise, that they had suffered a "silent" heart attack sometime in the past.

GOING BEYOND THE BLOCKAGE

As an individual with heart disease experiences symptoms that indicate their heart is not getting enough blood, they often find themselves in a brutal downward spiral. It begins when their doctor recommends a "routine" procedure to open or bypass a blockage (which may bring undesirable or even more serious side effects), and then instructs them to remain sedentary during a prescribed recovery period. This inactivity weakens their circulation even more, allowing other blockages to grow. In the process, blood flow to the heart may be further impaired and additional symptoms may develop. The patient finds that they must limit their activities, their quality of life has decreased, and their frustration and depression reaches new depths. Seeking a way out, they go back to their doctor, who recommends additional invasive procedures, and the downward spiral continues. The less they are able to do, the more likely they will need (or think they need) additional surgeries, and the more they will be required to remain sedentary during a recovery period, and so on. Before they know it, they barely recognize their lifestyle; they have become a shadow of who they used to be.

Given what we know now about heart disease, it is obvious that a patient will only break out of the vicious symptom-surgery-symptom cycle when their overall blood flow is improved. If the heart gets enough healthy blood flowing to it, the blockages become irrelevant.

There is no doubt that strong blood flow is absolutely critical to overall health and that we must do everything we can to keep our blood pumping. Heart disease sufferers are prime examples of the devastating effects that lack of blood flow to the heart can have on one's ability to live life to its fullest. Many do the best they can to modify their lifestyle choices and maximize blood flow. Many attempt to exercise, but are too limited by their heart disease to achieve enough blood flow to significantly improve their condition. If there were a way for heart patients to get a jump start, they would certainly seize the opportunity to get back on track.

What we need is a way for doctors to improve patients' blood flow for them — a passive form of exercise. It would curb the debilitating symptoms that signal the heart's cries for more blood and allow the heart to function normally, which would help the body function normally. Such an

aid would improve the patient's circulation, let them emerge from the rut of inactivity, and set them on an upward spiral where they can exercise on their own. With an outside aid to blood flow, patients could finally regain the active lifestyle they thought was lost forever.

A LOW-TECH SOLUTION FOR A HIGH-TECH PROBLEM

Historically, all attempts to restore normal blood flow to the heart in patients with coronary artery disease have addressed specific blockages, one at a time. Physicians would locate a blockage, and then attempt to surgically bypass it, push it out of the way using procedures such as balloon angioplasty and/or stent, scrape it away (atherectomy), or radiate it (brachytherapy). But while patients may experience immediate relief from these focused efforts to restore blood flow beyond a particular blockage, these procedures miss the underlying problem, are likely to offer only temporary benefit, and do nothing to stop the progression of the illness. Remember, heart disease is a system-wide illness, not a local one, and as such requires a system-wide treatment. This exciting discovery signals the opportunity to shift away from the

localized treatment approaches we have used for decades. Even more exciting is that a system-wide treatment already exists. It is EECP.

To understand EECP, we will examine it on three levels. First, what does it look and feel like? Second, what does it do to your blood flow? And third, what does it do to your blood vessels? Let's answer each question individually.

Case Study

Before EECP, Russell W., age eighty, had angina regularly after eating, while walking, or when breathing cold air. He had suffered five heart attacks, had undergone bypass surgery, and had had multiple stents implanted. He also had a pacemaker. In March 2004, more than a year after completing his EECP treatment, I received a letter along with three pictures of him parasailing four hundred feet in the air while on a cruise with his wife to celebrate his eightieth birthday. He wrote: "My cardiologist says I am in better health now than I was two years

ago. I am a poster boy for EECP. And I owe it all to you." A year later, he reported that he regularly walked a four-mile circuit in the park near his home and said, "My cardiologist is amazed I'm still walking around. I can do anything. As far as I'm concerned, EECP is the best thing you can do."

What Does EECP Look and Feel Like?

EECP is a beautifully simple treatment (see figure 2). You lie down on a comfortable, specially designed bed, and a therapist wraps a set of oversized blood pressure cuffs tightly around your calves, thighs, and buttocks. An air hose connects each cuff to an air compressor inside the bed. The blood pressure cuffs fill with air sequentially — first the calves, then the thighs, then the buttocks, with a fifty-millisecond delay between each — and then release simultaneously (see figure 3). The trigger for the cuffs to inflate and deflate — what makes the machine operate — is your own heartbeat. With three stick-on electrodes on your chest, the computer reads your EKG continuously throughout the treatment and

uses it to synchronize the inflation and deflation of the cuffs to your body's rhythms. When your heart beats, the cuffs relax. And when your heart rests, between beats, the cuffs squeeze around your legs, promoting blood flow back up to your heart and throughout your body. So the cuffs' squeeze-and-release rhythm — a "pumping" action — mirrors your heartbeat.

Figure 2. Dr. Braverman treating an EECP patient.

Feeling the cuffs inflate (squeeze) and deflate (release) around your legs is painless. It feels like a deep, rhythmic massage to your legs. You feel nothing above the waist and nothing in the heart or chest. And the synchronization to your heartbeat adds to the comfort and sense of relaxation during the treatment. It creates biofeedback, where hearing and feeling your own heartbeat encourages you to quiet your mind and enjoy the full benefit of the treatment. EECP is actually so comfortable that most patients listen to music, read, or even fall asleep during their treatment.

What Does EECP Do to Your Blood Flow?

The second layer in understanding how EECP works relates to what is actually going on with your blood flow and physiology, also known as *hemodynamics,* during the treatment. First, let's review a bit about the human circulatory system. The heart muscle is the body's pump. Every time it beats (the phase of the cardiac cycle known as *systole*), the heart contracts, sending blood throughout the entire body by way of the aorta, the largest artery in the body, and then the rest of the arterial system. After each contraction, the heart

rests for a moment (the phase of the cardiac cycle known as *diastole*). During this resting phase, blood returns from the body to the heart by way of the venous system, first passing through the lungs to pick up oxygen. The oxygenated blood enters the heart's chambers, so when your heart beats again, it sends that oxygen-rich blood back out to the body. During diastole (the resting phase), blood also enters the heart's own circulation (called *myocardial perfusion*) by way of the coronary arteries and provides the heart muscle itself with nutrients and oxygen. The two earliest branches

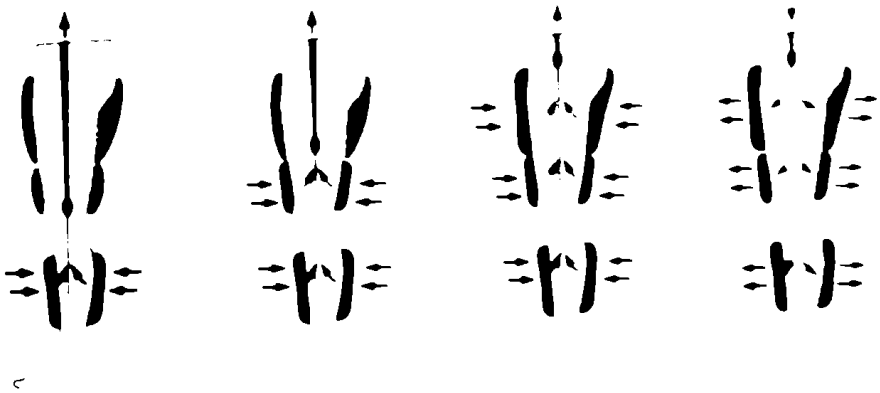


Figure 3. Schematic of EECP cuffs.

of the aorta (nearest to the heart) are the right coronary artery, which supplies the right heart, and the left main coronary artery, which divides into the left circumflex artery and the left anterior descending artery, and supplies the left heart (see figure 4). This process continues, over and over, approximately eighty times per minute, every minute of every hour, every hour of every day, every day of every year, for your entire life.

It is precisely during diastole — while the heart is resting — that the EECP blood pressure cuffs squeeze your legs, enhancing the natural return of blood to the heart. As the cuffs squeeze your legs with a circumferential pressure of 260 mmHg, blood flows retrograde through the arteries — that is, back up to the heart — and into the coronary circulation. The treatment has been shown to increase, or augment, diastolic blood pressure — a measure of the blood flow to the heart while the heart is resting, between beats — by 93 percent, and to increase overall blood flow to the heart by 28 percent.[4] These improvements are linearly related to the pressure of the EECP cuffs, meaning that the tighter the cuffs squeeze your legs, the more blood will flow into your heart muscle.

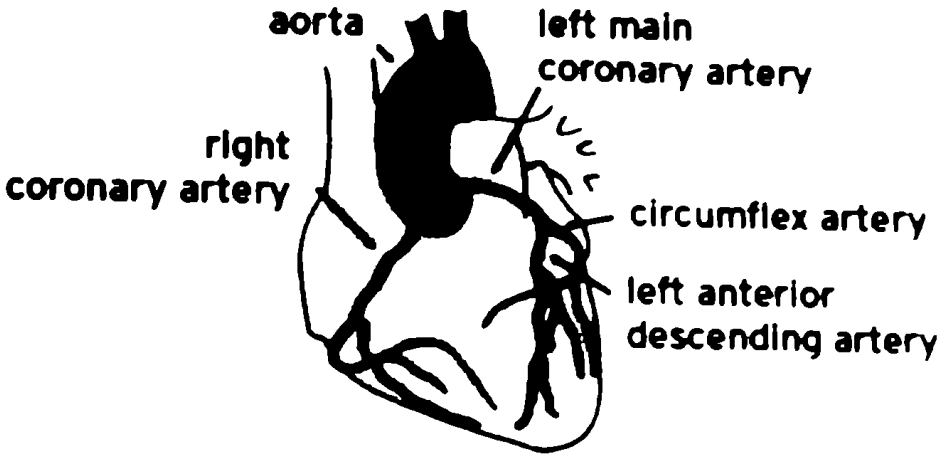


Figure 4. The heart.

We measure this blood flow back to the heart during EECP by placing a clip on your finger. The clip uses an infrared light to measure blood flow in the tiny arteries in your finger. This measurement, called a *finger plethysmographic waveform*, accurately reflects what is going on in your coronary arteries and all the arteries throughout your body.[5] We monitor and record this data several times during each treatment.

Just before the heart contracts again, the blood pressure cuffs rapidly deflate, thereby decreasing resistance to blood flow throughout the body (systolic pressure).

Doing so "unloads" the heart, making it easier for your heart to pump blood with greater force. As the heart is able to do its job more efficiently and with greater ease, it demands less blood and oxygen. Very simply, EECP assists the heart, feeding it extra oxygen and nutrients and decreasing its workload.

You may ask, "What is the point of all this blood flow, and how does it help people who have blockages in their coronary arteries?" The answer to this question is the key to what makes EECP such a remarkable tool in the fight against heart disease. Mother Nature, in all her wisdom, recognizes that the heart is the most important organ in the body and is essential for life. Accordingly, she has provided the heart with a backup plan to obtain blood if the main arteries are blocked or dysfunctional, as is the case in people with heart disease. This backup plan is the vast network of collateral, or extra, microscopic blood vessels in and around the heart. These collateral vessels are really "potential" blood vessels, and they are lazy by nature. If all of the major arteries in and around the heart are able to bring enough blood to the heart muscle, the collateral vessels are not needed and remain inactive.

However, if blockages in the main arteries prevent the heart from receiving adequate blood, the heart cries out to the body in the form of angina. Ideally, the body will respond by waking up those microscopic vessels and/or creating new ones to allow more blood to reach the heart. But in many individuals with heart disease, the body is not strong enough to develop collateral blood vessels on its own, and chronic angina persists. This is where EECP comes in.

As we all know, fluids travel the path of least resistance, and blood is no exception. In other words, it is easier for blood to flow through unblocked arteries than through blocked arteries. EECP sends more blood back up to the heart during its resting phase than blocked coronary arteries are used to accommodating, and so other blood vessels must step in. This is when Mother Nature's backup system swings into action. The increased blood flow created by EECP causes the tiny, lazy collateral blood vessels to wake up and begin doing their job. Once recruited in and around the heart, they enlarge and strengthen, creating new, lasting pathways for the blood to reach the parts of the heart that need it most, naturally bypass-

ing the blockages. These collateral blood vessels set off a positive chain reaction: the overall blood and oxygen supply to the heart is improved, allowing the heart to function normally again. In turn, angina is reduced or eliminated, enabling the patient to return to the activities they thought they had given up forever.

So, in a nutshell, EECP is an external heart and circulatory assistant that helps the body heal itself. It strengthens the heart's oxygen and nutrient supply, creates new pathways for this increased supply to reach the heart, and decreases the heart's oxygen demand and workload, making its fundamental job easier. In fact, the heart works less strenuously when you are receiving an EECP treatment than when you are asleep! And nurturing and supporting the heart while it rests allows it to work more efficiently when you are active.

Is there such a thing as too much blood flow? No. The body is smart. It has an inherent regulatory control that protects against excessive blood flow. A good example is the eye. A German study found that patients with circulatory problems in the eye who were treated with EECP enjoyed an increase in ophthalmic artery blood flow, while individuals with normal

ophthalmic arteries who received EECP treatments had no increase in blood flow to the eye. The study concluded that EECP may increase blood flow to the eye in people who need it, but not in people who do not.[6] Similarly, the body prevents any changes in blood pressure and blood flow from adversely affecting the brain, a process called *autoregulation*. So in both healthy people and heart disease sufferers, the increased blood flow in the body stimulated by EECP does not translate to adverse levels of blood flow to the brain. As we will see in chapter 5, the treatment *does* enhance blood flow to the brain in people who need it, such as those suffering from a stroke or dementia. In these individuals, just as in those described above with impaired blood flow to the eye, the body recognizes the need for additional blood flow to the affected area and responds accordingly.

Can all of this blood flow cause a piece of plaque to break off and become lodged, causing a heart attack or stroke? No. Plaque in blood vessels is not soft or delicate. In fact, it is quite the opposite. Plaque is largely made up of calcium; therefore, it is hard and strong like bone, creating tremendous resistance to

blood flow. The body, like everything else, obeys the laws of physics. One of these laws, as we have discussed, is that fluid travels the path of least resistance. It is easier for blood to travel through nondiseased vessels where there are no plaque obstructions than to fight its way through blocked arteries. This is precisely the process that naturally produces collateral blood vessels, and it explains why blood flow does not cause pieces of plaque to dislodge.

What Does EECP Do to Your Blood Vessels?

Blood vessels are not tubes or pipes like the ones under your sink. They are not fixed, inanimate structures. They are organs — alive, dynamic, and growing — that carry blood throughout your body. They need to be exercised in order to stay healthy, and the only way to exercise them is to give them adequate blood to transport. The more blood that flows through your blood vessels, the better they perform. Therefore, by increasing blood flow, EECP makes blood vessels healthier. I'll explain.

The friction, or shear stress, of blood moving along the endothelial cells (cells that line the blood vessels) releases natural

chemicals. These chemicals, called *angiogenic growth factors*, stimulate blood vessels to grow and mature. In humans, the very powerful vascular endothelial growth factor (VEGF) increases by as much as 21 percent in response to just one hour of EECP.[8] This dramatic increase in VEGF levels persists for at least one month, which in biochemistry is a staggering length of time.[9]

The shear stress that EECP creates also has an anti-inflammatory effect. Researchers at the University of Pennsylvania's Institute for Medicine and Engineering found that increased shear stress of blood flow on blood vessels — as achieved during exercise — can mimic the anti-inflammatory actions of powerful medications used to fight chronic inflammatory diseases.[10] The study provides the first direct evidence that the mechanics of blood flow are themselves anti-inflammatory. Increased blood flow — whether achieved during exercise or EECP — is a natural way to protect blood vessels and counteract inflammation, a key underlying cause of heart disease.

EECP improves blood vessels' ability to expand and contract (vascular reactivity), another of the many ways in which the

treatment recreates the beneficial effects of exercise and improves circulatory health. It does this by improving endothelial cell function throughout the body. Specifically, EECP affects two important substances that endothelial cells produce and release: nitric oxide (NO) and endothelin (ET-1).[11] These two substances are largely responsible for endothelial cell health and function. We will discuss each of them in turn.

Nitric oxide (also called *endothelial-derived relaxing factor*) promotes blood flow by dilating blood vessels. It also strengthens the arterial lining, making it resistant to clotting, cracking, and spasm, thereby helping arteries to function normally and protecting them from disease. There is considerable evidence that numerous conditions — including hypertension, obesity, high cholesterol, diabetes, heart failure, atherosclerosis, aging, and vascular injury — are associated with endothelial dysfunction and reduced nitric oxide levels. Anything that increases nitric oxide will have a long-term beneficial effect on heart disease and angina, and will improve the circulation in your entire body. EECP does just that. It increases nitric oxide by nearly 60 percent during

treatment and by 20 percent one month after treatment.[12]

Endothelin has several damaging effects on the body. It impairs blood flow by prompting blood vessels to constrict, forcing the heart to work harder against the increased resistance. It also causes the body to retain salt and water by increasing the levels of two hormones, aldosterone and atrial natriuretic peptide, thus contributing to the development of hypertension and congestive heart failure (CHF).[13] To illustrate endothelin's potency, studies involving heart failure patients have shown that blocking its activity prolongs life. EECP reduces endothelin levels in the body by nearly 40 percent during treatment and by 20 percent one month after treatment.[14] EECP also markedly decreases levels of another vasoconstrictor, angiotensin II.[15]

These positive effects of EECP emerge almost instantly. In fact, typically, nitric oxide levels rise and endothelin levels fall following the very first EECP session, and these biochemical changes persist throughout the course of treatment and over subsequent months. This partly explains why some patients feel better within the first week of starting their EECP program.

While it takes several weeks for collateral blood vessels to grow and develop, changes in cellular biochemistry occur almost immediately.[16]

A JUMP START

As passive exercise, EECP offers the jump start that heart disease sufferers need to get their blood flowing again and to set them on the path to better health and fuller lives. In the next chapter, we will look at the tremendous volume of evidence that makes EECP such an exciting alternative to surgery.

3

PUTTING IT TO THE TEST

Clinical Proof That EECP Works

The most exciting news about EECP is yet to come. Not only is it the most logical treatment for heart disease, which we now know to be a systemic condition. And not only is it simple, noninvasive, and painless. But we also have an enormous body of scientific evidence that unequivocally affirms that it works. EECP has been the focus of clinical research for more than thirty years. Leading medical journals, including the *Journal of the American College of Cardiology*, *Circulation*, and *Cardiology*, have published more than one hundred articles documenting EECP's safety and effectiveness. In this chapter, we will look at how the treatment has evolved over the years and at the proof that it is a powerful tool in the fight against heart disease.

While EECP is a newer medical innovation, the technology at the heart of the treatment has existed for more than fifty years. In the early 1950s, two Harvard researchers — brothers by the name of Kantrowitz — first experimented with the concept of counterpulsation as a technique to assist patients with what they termed "coronary inadequacies."[1] A decade later, that research was used to develop an internal counterpulsation device called the *intra-aortic balloon pump* (IABP). The IABP consists of a catheter with a small balloon attached to the tip, which is inserted through an artery in the groin (the femoral artery) and threaded into the body's main artery (the aorta). The IABP supports circulation in critically ill cardiac patients by inflating during diastole, the heart's resting phase, to help increase oxygen and blood flow to the heart muscle through the coronary arteries. The balloon rapidly deflates just before the heart beats, decreasing the heart's workload. The IABP is a lifesaving device and is still used every day to help sustain critically ill patients in circulatory crisis by providing immediate relief to the parts of the heart that are starving for

blood. The increased blood flow stimulates collateral vessels to grow and develop, creating new, sustainable pathways for blood and oxygen delivery throughout the heart. If this description sounds familiar, there is good reason. EECP works via exactly the same mechanism. The only difference is that the IABP works internally, while EECP works external to the body.

In the early 1960s, Birtwell, Soroff, and others developed the external counterpulsation device.[2] This first-generation apparatus was a hydraulic system that pumped water in and out of cuffs placed on the patient's legs. Along with promoting arterial blood flow back to the heart, like the IABP, this external unit offered the added circulatory advantage of stimulating flow from the veins and lymphatic vessels in the legs. Researchers were intrigued and eager to work with external counterpulsation because it was easy to use, it was safe, and it could duplicate the physical effects of the IABP while also promoting venous and lymphatic flow.

THE FIRST SIGNS OF SUCCESS

The Canadian Cardiovascular Society developed a classification system that gauges how angina symptoms affect an individual's

quality of life and ability to function. The system consists of four classes, with class I angina being the mildest and class IV angina being the most severe. The scientific research on EECP has focused on individuals who have class III or class IV angina. Class III describes a patient who has marked limitations on their ordinary physical activities, such as walking one or two blocks or climbing one flight of stairs. Patients with class IV angina are unable to engage in almost any physical activity without discomfort, and they may even have angina at rest.[3]

In the early 1970s, external counterpulsation was found to increase survival among patients treated during a heart attack and during cardiogenic shock (complete circulatory system failure), and it was also found to relieve angina. One of the first studies of external counterpulsation was conducted in 1973 by Banas, Brilla, and Levine. In it, twenty-one patients suffering from angina (seven with class III and fourteen with class IV) received a one-hour treatment daily for five days. Immediately after receiving the five treatments, seventeen of the patients were completely angina free. After one month, some of the patients had experienced a

mild recurrence of angina, but all remained significantly improved: ten had class I angina (defined as angina that may occur with strenuous activity or exercise only, not with ordinary daily activities), and eight had class II (which poses a slight limitation on ordinary activities such as walking or climbing stairs, but only when done rapidly or under emotional stress). This study was the first to demonstrate that external counterpulsation, by providing more blood and oxygen to the heart, reduces or eliminates angina. In addition to being reflected in the participants' everyday improvements, the results were documented objectively. When angiographies were performed on eleven patients after the treatment, five showed increases in the network of blood vessels (vascularity) around the heart.[4]

In another study, 129 patients experiencing a heart attack in an emergency room were treated with three hours of EECP during the first day, in addition to receiving the usual treatments of oxygen and medications. Researchers compared the outcomes of these patients to another group of 129 heart attack sufferers who were treated only with oxygen and medications. Those patients who were treated

with EECP not only had a lower death (mortality) rate than the other group (8.3 percent versus 17.5 percent), they experienced fewer complications as well.[5] One study found that the standard death rate of 85 percent among patients in cardiogenic shock can be drastically reduced to 45 percent by treating them in the first day with three to five hours of EECP.[6]

Sign of the Times

Despite these striking documented benefits, EECP technology did not receive significant widespread attention in the United States during the 1970s. Instead, our focus during this time period was on emerging high-tech, invasive approaches, such as coronary artery bypass surgery (CABG) and angioplasty.

Dr. John Gibbon (1903–1973) invented the heart-lung machine, also known as the *cardiopulmonary bypass machine,* and it was first used successfully on a patient in 1953. It marked a dramatic advance in medicine. With this device, a surgeon was literally able to bypass both the heart and lungs and allow the machine to take over the pumping and oxygenation of blood, so the patient would remain alive while the surgeon operated on their heart. The machine's first use was to repair a birth de-

fect in a woman by opening her heart muscle.

The first diagnostic coronary angiography was performed in 1958, enabling physicians to pinpoint blockages in coronary arteries and develop strategies to operate on them. In an angiography (also known as *cardiac catheterization*), a catheter is inserted into an artery in the arm or leg and guided to the heart, contrast dye is injected, and X-rays of the coronary arteries are taken to identify any blockages. This new diagnostic technique, coupled with added years of experience performing cardiac surgery, led physicians to assert in 1960 that it was safe to use the cardiopulmonary bypass machine to perform coronary artery bypass surgery. The first such operations were performed in the mid-1960s, and they continued to be refined for approximately a decade. By the time the first studies on EECP were published in the United States in the early 1970s, bypass had gained widespread popularity, with surgeons and hospitals moving quickly to incorporate it into their services. The popularity of bypass grew steadily — it was for many years the most widely performed operation worldwide — until 1995, when the number of proce-

dures performed annually began to plateau. Still, more than 515,000 such operations are now performed each year in the United States at a cost of $31.3 billion.[7]

Bypass was not the only technologically advanced procedure that quickly gained credibility and large-scale adoption during this time. The first human coronary balloon angioplasty was performed in 1977, and the first use of a coronary stent in a human was reported in 1987. A variety of other cardiac interventional devices were also invented and perfected in the years from 1987 to 1993, including lasers, rotational atherectomy devices (Rotablator), and various types of stents. The use of angioplasty and stents has grown steadily since then; in 2000, the number performed annually in the United States surpassed that of bypass. The number of angioplasties, for example, skyrocketed by 324 percent between 1987 and 2002. Presently, 1,204,000 angioplasties and stent implantations are performed annually at a cost of $34.3 billion.[8]

Use in China

While the American medical establishment turned its attention in the 1970s to high-

tech surgical procedures to treat heart disease, EECP was far from forgotten. Tremendous interest in the treatment was growing in China, where physicians were captivated by its noninvasiveness and cost-effectiveness. EECP is consistent with Eastern philosophy, which teaches that medical treatments should help the body heal itself, enhancing and aiding its natural tendencies rather than interfering with them. China has begun to adopt more Western approaches in recent years. But at the time, surgery and other invasive techniques were used only as an absolute last resort.

In the 1970s, Dr. Zeng Sheng Zheng and his colleagues at the Sun Yat-sen University of Medical Sciences in the People's Republic of China refined the technology behind EECP, developing the more comfortable and easier to use sequential pneumatic (air) cuff mechanism. This is the design used today, in which the blood pressure cuffs inflate from the calves to the thighs to the buttocks, promoting the flow of blood back up toward the heart. Chinese scientists also added arm cuffs to the treatment, calling it SECP (sequential ECP).

By 1990, 1,800 EECP centers were op-

erating in China. A large study of more than six thousand patients was published there, and it concluded that the treatment offered improvement to more than 90 percent of participants. Another long-term study there found that 74 percent of EECP patients maintained improvement in their heart disease symptoms seven years after completing their treatment, and they were four times less likely to suffer a cardiac death in the eight years after receiving EECP than heart patients treated with medication alone.[9]

Between the mid-1970s and the mid-1990s, EECP became the first and most trusted treatment for heart disease in many parts of China. A number of factors explain why. As mentioned, the Chinese tended to perform surgery only as a last resort. Therefore, invasive procedures such as bypass and angioplasty, which proliferated in the United States, were nearly unheard of in China. In addition to the prevailing preference for noninvasive treatments, EECP was attractive because of its proven effectiveness and safety.

The structure of China's health-care system at that time holds another key to understanding EECP's tremendous popularity there. Until several years ago, physi-

cians in China were not paid per procedure or office visit. Instead, they received a salary based on their success in keeping their pool of patients out of the hospital. (The structure, of course, is just the opposite in the United States. Here, doctors are compensated when patients require consultations, undergo tests and procedures, or are hospitalized.) Therefore, the overall goal of physicians in China was to help patients avoid unnecessary procedures and complications and to stay healthy. It is no wonder that more than one million individuals there have received EECP! And in China, EECP is not just a once-in-a-lifetime treatment. On the contrary, most individuals who receive EECP do so periodically, with regular maintenance programs being the norm.

Today, China's health-care industry is in a state of flux, and like many aspects of the country's culture, seems to be taking Western cues. The medical system appears to be heading toward a structure more like the one in the United States, and invasive procedures are being used more widely. However, many advocates of EECP are currently working to ensure that the treatment is considered to be in line with modern cardiac therapy, and to reestablish

it as the heart disease treatment of choice.

China has found enormous success improving lives with EECP, not only in cardiac patients, but in individuals with a wide variety of circulatory conditions, including strokes, Parkinson's disease, and visual impairments. China is decidedly ahead of the curve in discovering and implementing EECP's varied applications, and it offers us an exciting glimpse of things to come. We will look at the long list of documented noncardiac benefits of EECP in chapter 5.

A FOOTHOLD IN THE UNITED STATES

Cardiologists in the United States began to show renewed interest in EECP upon the publication of a scientific paper in 1992. Authored by researchers at the State University of New York, Stony Brook, the article documented the results when EECP was provided to eighteen desperate heart patients who had debilitating angina despite all surgical treatments and medications and who were considered inoperable. All patients had nuclear stress tests before starting their EECP treatments, and all their tests were abnormal, indicating inadequate blood flow to areas of the heart.

All eighteen patients received thirty-five one-hour EECP treatments over a seven-week period (one hour per day, five days per week). When the treatment course was complete, all patients' angina improved and no side effects were reported. Sixteen (89 percent) of them were symptom free during their usual daily activities. Twelve (66 percent) had completely normal nuclear stress tests at the end of the program, indicating that normal blood flow had been restored throughout the heart, while two patients (11 percent) had significantly improved (but still abnormal) stress tests. The fourteen patients (77 percent) with improved nuclear scans were able to exercise 22 percent longer on a treadmill after receiving EECP. In four patients (22 percent), stress test results did not change.[1]

These remarkable results shocked the cardiology community. But the real question was, would the benefits last? The answer came when the original team of researchers published a three-year follow-up study on the same eighteen patients. Some patients' medications had been adjusted in the time since their EECP treatment, and eight patients had received additional EECP treatments — but no other interventions — during the three

years since their initial course. Of the original fourteen patients whose stress tests improved, eleven (79 percent) had sustained improvement over the three-year follow-up period, remaining symptom free. One had suffered a heart attack, one had undergone bypass surgery, and one was lost to follow-up. Of the four patients who had unchanged nuclear stress tests but improved angina, two remained without significant angina, one had had bypass surgery, and one had undergone angioplasty. These patients came into the original study with severe, disabling heart disease symptoms that had failed to respond to all medications and treatments prior to EECP. But three years after receiving EECP, fourteen (78 percent) of them remained free of disabling symptoms and none had died.[11]

A Longer Life Span Can Mean More Heart Disease

The renewed interest in EECP was largely due to the changing face of the American cardiac patient. Advances in health care in recent decades have increased our life span, making Americans more likely to live long enough to develop heart disease. This trend extends to existing cardiac patients; new

medications and treatments have extended their life expectancy as well, increasing the need for suitable treatments for older, frail heart disease sufferers who have advanced conditions. For example, the millions of individuals who underwent bypass surgeries and angioplasties in the 1970s through the early 1990s are surviving longer. As they age, symptoms of this chronic disease will continue to reappear, prompting them to return to their doctor each time. However, older cardiac patients are likely to develop additional medical problems, making it much more dangerous to perform repeat surgical or other invasive procedures. Given the growing population of aging, frail, and complicated heart disease sufferers, it is easy to see why cardiologists took note of these early, encouraging findings on EECP — a safe, noninvasive treatment option — and why researchers embarked on many additional studies to further evaluate EECP's efficacy.

The FDA Gives Its Stamp of Approval

In the ensuing years, numerous studies were published, and all reinforced EECP's safety and effectiveness. In response, the FDA approved EECP in 1995 as a treatment for chronic stable angina and cardio-

genic shock, as well as for use during a heart attack. These are the same FDA-approved indications for the intra-aortic balloon pump (IABP). In a study from Dokkyo University School of Medicine, Tochigi, Japan, comparing the IABP to EECP in patients who underwent urgent angioplasty after a heart attack, the two devices were found to be equally effective in restoring lifesaving blood flow throughout the heart. In fact, EECP was slightly more successful in increasing blood pressure in collateral vessels and improving the strength of the heart's contraction.[12] After these studies were published, EECP was affirmed as a noninvasive IABP, and it joined the ranks of lifesaving devices. Most recently, in June 2002, the FDA expanded the list of EECP's approved uses to include the treatment of congestive heart failure. We will discuss this promising development in detail in chapter 4.

Published Studies Proliferate

As EECP was slowly introduced to patients across the country and abroad in the 1990s, the body of scientific literature on the treatment steadily grew. One of the most important areas of study focused on EECP's lasting benefits, which have since been con-

firmed time and again. One investigation by Dr. William Lawson, a leading researcher in the field of EECP, looked at thirty-three patients with the most advanced form of heart disease. These patients still suffered considerably despite having undergone multiple surgeries and invasive procedures and taking numerous medications. They each received thirty-five hours of EECP and were then followed for a period of five years. Initially after completing the course of EECP treatments, all thirty-three patients saw an improvement in their angina. Nuclear stress tests revealed that twenty-six (79 percent) of the subjects had improved blood flow in their hearts, and eleven (33 percent) of them were able to cut back on their cardiac medications. Over the following five years, thirteen (40 percent) of the patients received additional EECP treatments; twenty-nine (88 percent) were still alive. Of the twenty-six patients whose stress tests improved immediately after EECP, twenty-four required no surgery or procedures during the five years following their treatment, nor did they suffer a heart attack. Only one of the original group went on to have a heart attack, and two underwent surgery, an extraordinary statistic when you consider that these were classified

as end-stage heart patients, being inoperable with symptoms that do not respond to other treatments or medications (refractory angina). Remarkably, these outcomes were similar to those of elective bypass surgery performed on low-risk, first-time cardiac patients.[13]

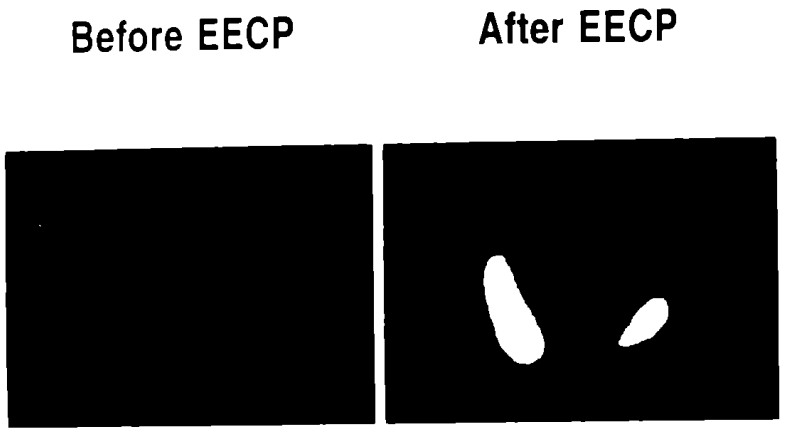


Figure 5. Positron emission tomography scans demonstrating improved blood flow to the heart after EECP.

Multiple studies have documented the improved blood flow to the heart, or myocardial perfusion, that EECP creates. Positron emission tomography (PET) scan images, our most accurate measure of cardiac blood flow and oxygen delivery, captured before and after EECP, illustrate this phenomenon (see figure 5).[14] The

body responds to this increased blood flow by developing and enlarging collateral coronary arteries — additional pathways for blood to reach the heart.

EECP not only improves angina and myocardial perfusion, it has also been shown to offer long-term preventative and protective benefits in heart disease patients. Another long-term follow-up study compared 117 patients who received EECP to 198 patients treated only with medications over a seven-year period. The researchers found that the patients treated with medications alone were 2.3 times more likely to have a heart attack or cardiac-related death than those who underwent EECP.[15]

Weighing the Alternatives

Let's compare some of this outcome data to bypass surgery and angioplasty data (see figure 6). The Bypass Angioplasty Revascularization Investigation, or BARI study, the largest randomized clinical trial to compare bypass surgery and angioplasty, found that 21 percent of bypass patients and 22 percent of angioplasty patients had heart attacks or died during the first five years after surgery. In addition, 8 percent of bypass patients and 54 percent of angioplasty

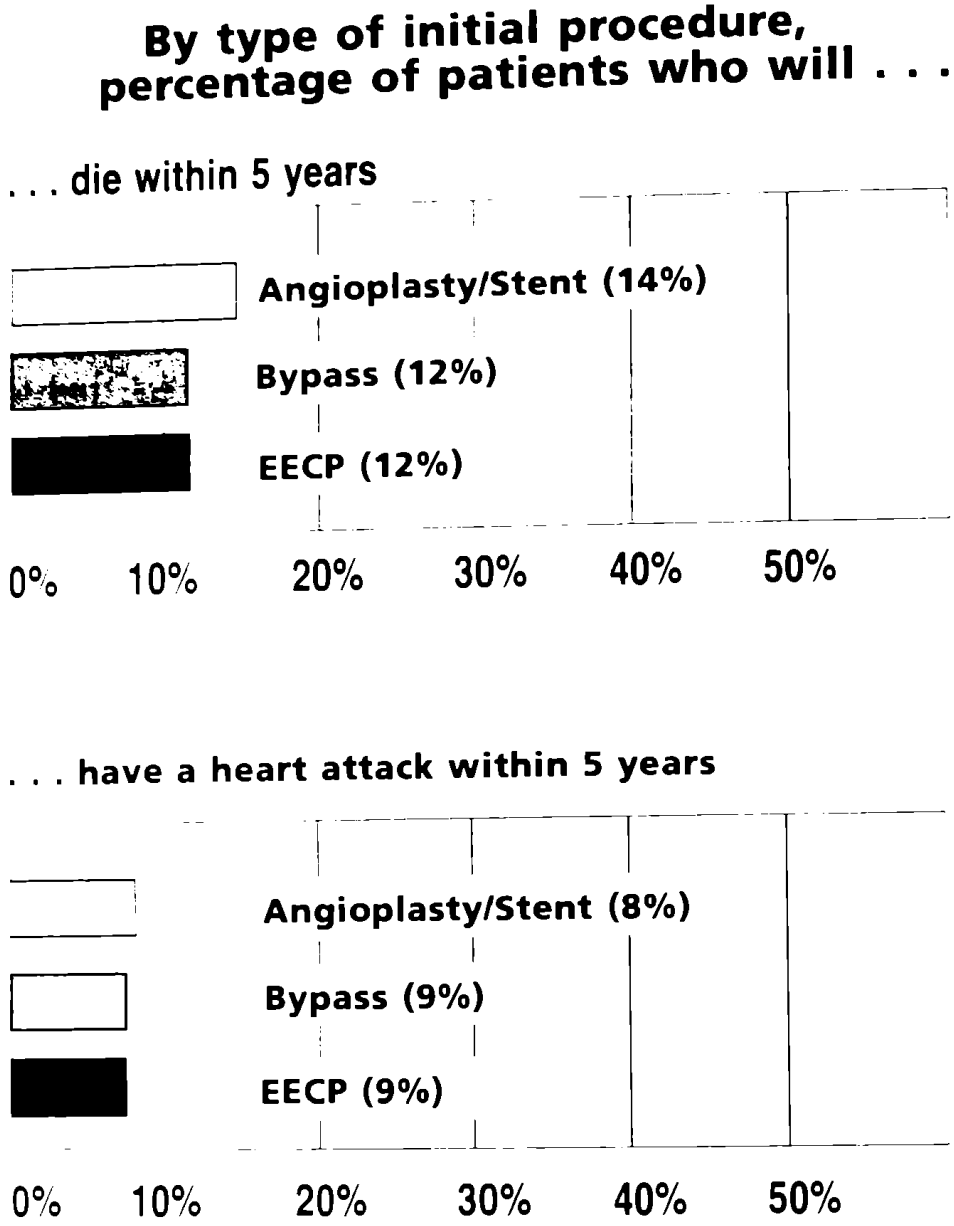


Figure 6. Risk of death or heart attack for angioplasty/stent, bypass, and EECP patients. Note that angioplasty/stent and bypass recipients were uncomplicated, first-time patients, while EECP recipients were end-stage patients who had failed surgery and/or invasive procedures. [16]

patients required repeat surgery or other invasive procedures within the five-year period.[17] During the first year of follow-up in the German Angioplasty Bypass Surgery Investigation, 18 percent of the patients who had bypass surgery died, had a subsequent heart attack, or required additional surgery.[18] The Randomized Intervention Treatment of Angina (RITA) study found that 16 percent of bypass patients and 17 percent of angioplasty patients had heart attacks or died during the first 6.5 years after surgery. In addition, 13 percent of bypass patients and 45 percent of angioplasty patients underwent repeat surgery or invasive procedures within the same time frame.[19]

A comparison of 323 refractory angina patients (who experience persistent symptoms despite trying all possible medications and invasive or surgical procedures) treated with EECP to 448 patients earlier in the progression of their heart disease who underwent elective, nonemergency angioplasty is also quite interesting. First, the EECP patients had much more complicated medical histories, including previous angioplasty (53.0 percent versus 33.3 percent), previous bypass surgery (42.1 percent versus 18.6 percent), pre-

vious heart attack (56.4 percent versus 27.8 percent), history of congestive heart failure (16.8 percent versus 9.2 percent), and history of diabetes (37.9 percent versus 23.5 percent). In following up one year after the two groups of patients received their respective treatments, researchers at the University of Pittsburgh (Pennsylvania) found that the survival rate was the same in both groups, over 96 percent. The percentage of patients who underwent bypass surgery in the year since the initial treatment was also the same in both groups, about 5 percent. Repeat angioplasty rates were higher than repeat EECP rates during the first year. Remember, the EECP patients were much

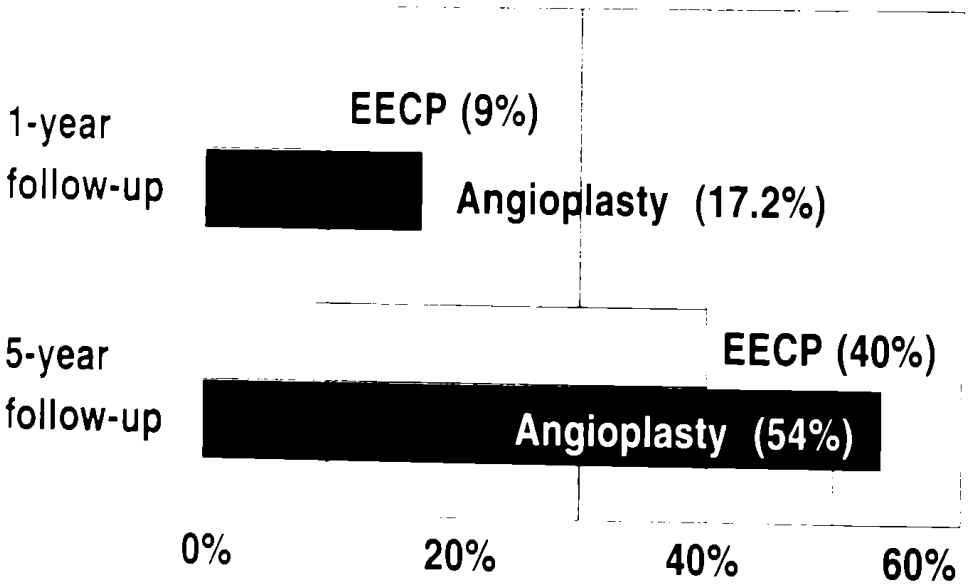


Figure 7. Repeat treatment rates for EECP and angioplasty patients. [20]

sicker at the outset, had more complicated medical histories, and had fewer repeat treatments, yet they achieved the same outcome with EECP as the less-ill patients did with angioplasty (see figure 7).[21]

WIDE-RANGING BENEFITS

From reducing patients' time in the hospital to helping them become active again to improving their emotional outlook and enjoyment of life, EECP's benefits are wide-ranging and dramatic. Here, we will review them in detail.

Increasing Activity Levels and Improving Quality of Life

EECP enhances a patient's ability to exercise and engage in physical activity. The increase is measured in terms of treadmill time and myocardial perfusion during an exercise stress test. In one study, investigators at New York Medical College, Valhalla, looked at patients' maximum exercise ability before and after receiving EECP. Twenty-five patients with angina exercised as much as they could until they had to stop, whether due to chest pain, shortness of breath, fatigue, or other symptoms (called a *maximal symptom-limited exercise tolerance test*). At the end of their thirty-

five-hour EECP program, twenty-three of the twenty-five patients (93 percent) had reduced or eliminated symptoms and improved their ability to perform daily routine and leisure activities without limitation. During the stress test following their treatment, these patients were able to walk longer and faster on the treadmill before experiencing symptoms. Their EKGs and cardiac blood flow improved, even though they were exercising more vigorously than before. These results illustrate that when the heart gets more blood flow, it is able to work harder, longer, and more efficiently.[23]

Predicting Success

Is there a way to forecast which patients will achieve the best results with EECP? This is always an important question in medicine. We try to select the patients we expect will do well with a particular treatment in order to help as many patients as possible. With EECP, the anatomy of the heart's circulation seems to play a role in predicting success. Three major arteries feed the heart. Of course, they later branch and divide numerous times, so there are many

important arteries in and around the heart, but at the beginning of the heart's circulation, there are three major arteries. Patients are classified based on how many of these three arteries are diseased or narrowed, and they are referred to as having one-, two-, or three-vessel disease. In one clinical study, fifty patients underwent a cardiac catheterization to classify the severity of their heart disease by determining how many of their major arteries were blocked. After completing a full course of thirty-five EECP treatments, all patients reported decreased angina, and each underwent a nuclear stress test to quantify their success. Of those with one, two, and three major blockages, 95 percent (eighteen out of nineteen), 90 percent (seventeen out of nineteen), and 42 percent (five out of twelve), respectively, had improvement in cardiac blood flow. The overall average rate of effectiveness was 80 percent (forty out of fifty), EECP's often-quoted success rate. [22]

In trying to predict which patients will do best with EECP, it is believed

that if a patient has at least one good vessel, whether it is one of their three original vessels or an open vessel from a previous bypass surgery or other procedure, that vessel will allow blood to flow deeper into the heart muscle before branching into the collateral network. This open artery improves blood pressure and volume in the farthest reaches of the heart's circulation, which paves the way for lasting results. More extensive heart disease responds more slowly because there are fewer available collateral vessels to bring blood to the heart, but these patients also respond well in time. Therefore, patients with extensive disease routinely receive extended courses of treatment (fifty treatments or more) in order to achieve the desired results.

Another study, involving 175 angina patients, was performed at seven centers in the United States, Europe, and Asia. Three-quarters of the participants had previously undergone angioplasty or stent

placement, and 41 percent had undergone bypass surgery. About half (51 percent) had suffered at least one heart attack, and 21 percent had diabetes. All subjects underwent a maximal symptom-limited exercise tolerance test before receiving EECP to measure their baseline ability to exercise. After receiving a full course of thirty-five EECP treatments, angina improved in 85 percent of the patients, and none of the patients' conditions worsened. Ninety-seven of the patients underwent stress tests during which they exercised at the same level as they did during the test prior to treatment, meaning the test was terminated when the patient reached their pre-EECP maximal exercise level. Compared to the baseline test, 83 percent of the patients had improved blood flow to their heart. The remainder of the patients underwent a maximal stress test, similar to the one before receiving EECP, and all were able to exercise significantly longer before they had to stop. In addition, 54 percent of those patients whose maximal exercise capacity improved after EECP had corresponding improvement in blood flow to their heart. When an individual exercises to the maximum, their heart requires much more blood. Since EECP

does not open blocked arteries, this study demonstrates that the treatment created *natural* bypasses, improving blood flow to the heart *around* the blockages, in 54 percent of participants. Follow-up six months later found that patients retained these benefits.[24]

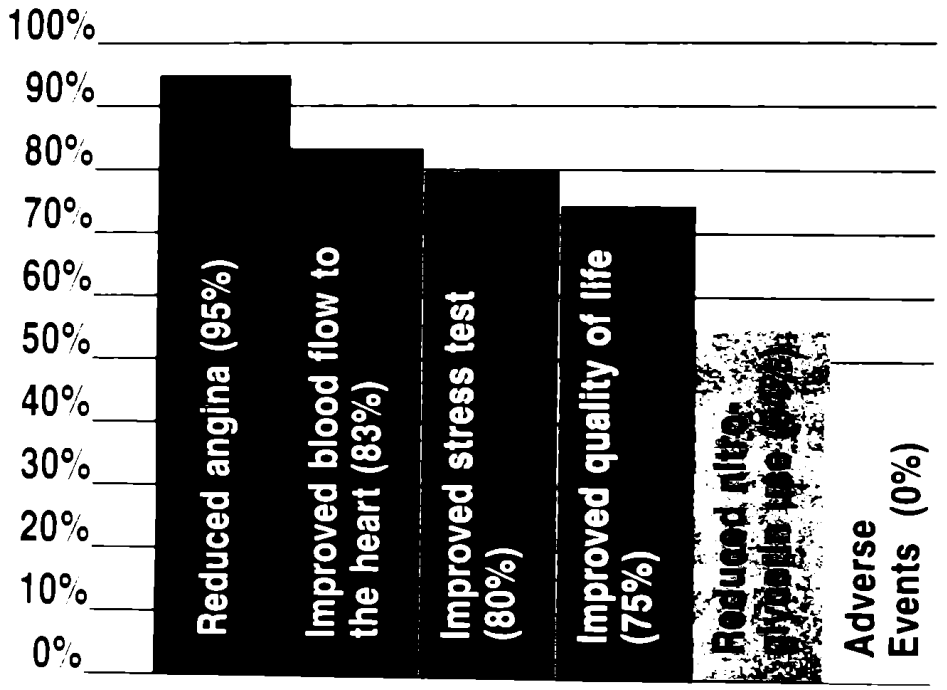


Figure 8. The benefits of EECP that last three or more years.

Reducing Hospital Stays

EECP has also been shown to reduce the frequency and length of hospital stays for the sickest heart patients. A study in Ireland involved forty inoperable patients whose angina did not respond to medications. At

the end of thirty-five EECP treatments, 87 percent of participants responded with dramatically improved angina, ability to exercise, and blood flow to the heart. The average number of days they spent in the hospital dropped from 14.5 in the year prior to receiving EECP to 7.8 in the year following treatment. EECP had a significant impact on these patients' quality of life. They experienced improvement in physical functioning, general health, energy, emotional health, and social functioning.[25]

Improving Emotional Health

Patients' sense of well-being — their general perception of their health and quality of life — also improves with EECP. One study from the State University of New York, Stony Brook, looked at both the treatment's quantifiable physical outcomes and its psychosocial effects. After completing their course of EECP, nuclear stress tests revealed that 75 percent of participants had improved blood flow to the heart. The average frequency of all participants' angina decreased by 85 percent, and their average nitroglycerin use dropped 96 percent. No patients reported psychological or emotional stress as a result of the treatment. In the formal psychosocial evaluation after

treatment was complete, all patients reported improvement in their energy level, sense of well-being, overall health condition, and ability to work. Two-thirds reported improvement in their family life and social life, and one-third reported improvement in sexual activity.[26]

Another study, conducted at Massachusetts General Hospital in Boston, demonstrated that EECP significantly reduces depression, anxiety, and physical manifestations of emotional stress (somatization). Given the fact that depression significantly increases the risk of cardiac-related death, EECP's ability to alleviate depression is a critically important finding.[27]

A NEW SET OF RULES

Numerous other studies conducted throughout the 1990s confirmed that EECP improves exercise capacity, blood flow to the heart, and quality of life and that it reduces angina, heart attacks, surgery rates, nitroglycerin use, and the frequency and length of hospital stays in even the sickest heart patients. Despite this data, however, most physicians in the United States were unwilling to change the way they treated their heart patients. By and large, they would not consider offering EECP even to their end-

stage cardiac patients — those who were unable to undergo additional surgeries or procedures and were still suffering despite being on maximum medications. Most physicians refused to accept that EECP worked. They discounted the research, suggesting the documented improvements were due to the placebo effect (because patients believed they would get better from the treatment). But how could patients change their EKGs, stress tests, and nuclear scans by just thinking positively? Clearly, ample scientific evidence existed to rule out the placebo effect.

The Scientific Gold Standard

The gold standard of clinical research is the randomized, placebo-controlled trial, in which subjects are randomly divided into two groups: one that will receive the real treatment and one that will get a fake, or sham, treatment. The group that receives the sham treatment is called the control group. None of the subjects know which group is which; they all have an experience that looks and feels like the real thing. Only the physicians conduct-

ing the research know who is receiving an actual medical therapy and who is not. Those who evaluate the study's results are also unaware of which group is which until their calculations are complete, thus ensuring the data is interpreted with complete objectivity.

Many doctors who discounted the research on EECP criticized the fact that none of the studies included a control group. They wanted a gold-standard study.

Keep in mind, though, that comparative studies (which compare outcomes in two different treatment groups without a control group) and outcome studies (which follow one treatment group over time) such as the ones conducted to evaluate the effectiveness of EECP up to that point are well-accepted and widely used to shape medical practices. Bypass surgery, angioplasty, and stents are cases in point. There has never been, nor will there ever be, a randomized, placebo-controlled study of real versions of these invasive procedures versus sham versions. Medical ethics prohibit them, because sham procedures would expose patients to risks of bleeding,

infection, heart attack, stroke, or even death while offering them no potential benefit whatsoever. In the case of bypass surgery, performing a sham procedure would require a surgeon to remove a vein from the subject's leg, cut open their chest, and then discard the vein and close the chest without performing the operation. A sham angioplasty or stent procedure would require a cardiologist to insert a needle into the patient's groin, thread a catheter into a blocked coronary artery, and then pull the catheter out without performing a procedure. Then researchers would have to follow, over months or years, the control group patients and compare their outcomes to those who underwent real procedures. Obviously, these invasive procedures could never be held to the gold standard of scientific research.

Instead, physicians have concluded that bypass surgery, angioplasty, and stent placements are useful in treating coronary artery disease by comparing data on those who underwent these procedures with those who were treated with medications only. In the case of bypass surgery, these comparative studies showed that only patients with very specific conditions benefit more from bypass surgery than from medi-

cation. The specific disease states that have been shown to benefit from bypass surgery are significant left main coronary artery blockage, triple-vessel disease with an ejection fraction of less than 50 percent, or an equivalent anatomic state. No studies support bypass surgery in other, more common clinical circumstances, such as those that would be treated with single or double bypass procedures, or triple-vessel disease with normal ejection fraction.[28]

So even without studies involving a control group, these invasive procedures became the norm in treating heart disease. Today, these procedures are performed at a rate of more than 1.7 million per year. Despite the widespread use of invasive procedures with only comparative and outcome studies to support them, the medical community held EECP to a higher standard.

Earning the Gold

The medical community's skepticism about EECP was finally quieted in 1999, when leading cardiologists from Columbia, Yale, Harvard, and other universities published the results of their Multicenter Study of Enhanced External Counterpulsation, or

MUST-EECP. In the study, half of the 139 participating angina patients received thirty-five real EECP treatments, while the other half received thirty-five sham (placebo) treatments. Patients receiving a placebo treatment got on the EECP bed, were connected to an EKG, and had the cuffs wrapped around their legs. However, the cuffs would squeeze only minimally, and therefore did not promote blood flow to the heart. These control group patients did not know they were getting a sham treatment, since they had never received a real treatment to compare against.

Treadmill stress tests were performed on both groups before and after treatment. During the test following treatment, those who had received genuine EECP were able to exercise significantly longer without symptoms or EKG changes than they could prior to the treatment. There was no difference in the sham group's ability to exercise without such abnormalities. These results mean that the real EECP group had more blood and oxygen flowing to their hearts after treatment, and they were therefore able to exercise longer before the EKG indicated their heart's demand for blood was exceeding its supply. They also had less angina and used less nitroglycerin

than before EECP. There were no adverse events, side effects, or treatment complications in either group.[29] At the end of the thirty-five-hour treatment course, and again one year later, patients who received actual EECP reported sustained improvement in their ability to perform daily living activities, ability to work, pain level, energy level, confidence in their health, ability to socialize, anxiety level, depression, and angina.[30]

The MUST-EECP study prompted Medicare to begin paying for EECP in 1999. Since then, most private health insurance companies have followed suit, and dozens of additional studies have demonstrated that EECP is an effective treatment for nearly all patients with coronary artery disease, including high-risk, complicated patients such as those who have already undergone multiple cardiac procedures, those who have diabetes or congestive heart failure, the elderly, and the frail.

Applying EECP in Diverse Settings

The MUST-EECP study was conducted in the ivory towers of institutions such as Yale, Columbia, and Harvard. Its results were impressive, and they prompted Medicare to formally recognize the treatment. But

another group was looking at whether EECP was more widely applicable. The EECP Clinical Consortium, organized in 1995, included diverse practice settings (university hospitals, community hospitals, physicians' offices, and rehabilitation facilities) with varying degrees of experience in treating patients with EECP. Its goal: to assess whether the treatment was more successful when offered in certain clinical settings than in others.

One consortium study looked at 2,991 patients who had received EECP at eighty-four different sites across the country. All patients tolerated the treatment without difficulty, and angina improved by at least one class in 73.4 percent of participants. Women and men did equally well, and patients treated in a small private practice did just as well as those treated in a university hospital. At the end of their treatment, none of the patients had experienced a decline in their cardiac health or any negative effects from the treatment.[31]

The International EECP Patient Registry (IEPR) is another large-scale initiative to document EECP's safety, effectiveness, and patterns of use. Established in 1998, the IEPR is an independent, anonymous, volunteer patient registry

housed at the University of Pittsburgh's Epidemiology Data Center. During the IEPR's first phase, more than five thousand angina patients treated in 140 centers around the globe (121 in the United States and 19 abroad) were enrolled, and their progress was followed for three years. Here are some fast facts about the participants:

- The average age was 66.8 years (in all, 59.7 percent of the patients were over sixty-five).
- The majority, 75.5 percent, were male.
- The average time since they had been diagnosed with heart disease was 10.8 years.
- The majority, 78 percent, had multivessel disease.
- Most, 85.8 percent, had undergone at least one bypass surgery and/or angioplasty or stent placement before receiving EECP.
- Two-thirds, 67.6 percent, had suffered at least one heart attack before receiving EECP.
- Nearly one-third, 31.7 percent, had congestive heart failure.

- Many, 41.3 percent, had diabetes.
- The vast majority, 84 percent, were deemed inoperable.

After following these patients for three years, IEPR researchers published impressive data. The lasting improvement in angina was staggering. Figure 9 presents a summary of their progress. Before receiving EECP, 68.8 percent of the patients regularly used nitroglycerin. Three years later, that number had decreased to 44.4 percent (see figure 10).[32]

Angina Class	Class IV	Class III	Class II	Class I	No Angina
Before EECP	23%	58%	15%	4%	0%
Three Years after EECP	5%	16%	25%	19%	35%

Figure 9. Angina classification before and after EECP.

Looking ahead, the IEPR's second phase will involve treating patients with EECP until a preset goal of reduced symptoms is achieved, rather than stopping after the standard thirty-five-hour course. Several

substudies will examine how EECP improves particular issues related to diabetes, peripheral vascular disease, and erectile dysfunction.

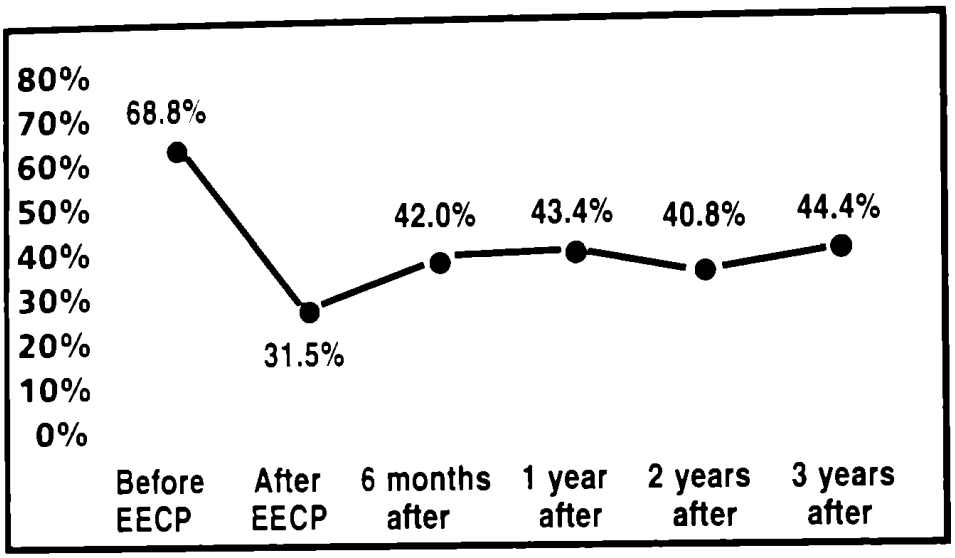


Figure 10. Nitroglycerin use before and after EECP.

Using EECP Sooner Rather Than Later

The decision to reserve EECP until all other options have failed is a purely American construct, a result of our preference for invasive procedures. To illustrate this point, consider that while only 5 percent of the world's population resides in the United States, almost half of the world's angioplasties, stents, and bypass operations are performed here. These procedures are typi-

cally the first step in treating an American's heart disease, but they are more often reserved as last resorts in other parts of the world such as Canada and Europe.[33] And as we saw earlier, in China EECP achieves equally impressive results when it is used sooner rather than later in the progression of a patient's illness.

Turkey is another country that usually offers noninvasive treatment earlier than the United States. The average EECP patient in Turkey is younger than their American counterpart (57.8 years versus 67 years) and receives the treatment for milder symptoms (only 67 percent of Turkish EECP patients have class III or class IV angina versus 84 percent of those in the United States). EECP recipients in Turkey are also less likely to have undergone a prior angioplasty, stent, or bypass operation (54 percent versus 86 percent), and they are less likely to be considered inoperable (55 percent versus 81 percent). A study comparing Turkish EECP patients with Americans who received the treatment found that both groups had the same success rate, measured in terms of reduced angina, reduced nitroglycerin use, and improved quality of life.[34]

Using EECP to Treat Unstable Angina

Most patients in the United States who are treated with EECP have stable (predictable), chronic angina, and the treatment's benefits begin to emerge within a few weeks. But what about patients with unstable angina, the type that comes on suddenly and quickly becomes more severe? In one study, researchers examined how both types of angina patients responded to EECP. Both groups enjoyed substantial reduction in their angina; 74 percent of the stable patients and 80 percent of the unstable patients improved to the same degree. And both groups experienced the same rates of reduction in nitroglycerin use along with improved mood and ability to enjoy physical activities without limitation. While the medical community has not come to a consensus on where EECP belongs in the scope of treatments offered to patients with unstable angina, these findings indicate that it does have a place and should be further investigated.[35]

UNHEARD-OF SUCCESS RATES

The large body of clinical research on EECP offers consistent evidence that the treatment is suitable and safe for nearly

every heart patient. Whether your heart disease is newly diagnosed or you have been living with it for years, whether you have no other notable ailments or have numerous complex medical conditions, EECP achieves practically unheard-of success rates of 80 to 90 percent. In the next chapter, we will look at exactly what you should expect during treatment, how patients who have undergone other cardiac procedures in the past respond to EECP, and what makes it an appropriate treatment for so many different groups of heart disease sufferers.

4

WHAT TO EXPECT DURING EECP

Logistics, Specifics, and Special Cases

With a full, current understanding of heart disease as a system-wide illness and the highly effective, system-wide treatment approach that EECP offers, most patients want to know how the treatment might apply to their particular situation. How will it fit into your daily life? What is the typical treatment schedule? What if you have undergone other cardiac procedures in the past? Is EECP just as effective in women as in men? What if you have other ailments, such as diabetes or congestive heart failure? In this chapter, we will answer all of these questions and more.

EECP is like passive exercise: it gets your blood pumping the same way a vigorous, sustained cardiovascular workout does, but it does so while you're lying down! While EECP does not offer *all* the benefits of exercise, such as increasing your metabolic rate or burning calories, it does recreate the circulatory benefits of exercise while you are relaxing on the treatment bed. The repetitive blood flow stimulates your blood vessels to grow, develop, and function at their highest level.

Case Study

Patricia C., age forty-six, was relatively healthy, until one day, while attending her son's high school graduation, she had a sudden heart attack — right on the football field. From that moment, she had persistent angina without relief. She underwent an angioplasty and a stent placement, but her condition did not change. Four months later, she had a repeat angioplasty followed by radiation (brachytherapy), again with little improvement.

Finally, she had a triple bypass. But within one month, her angina returned, just as severe as before. A repeat catheterization found that two of the three bypasses had already closed. Patricia's angina occurred daily with most activities, at rest and even during sleep. Her husband, sons, and parents would not let her do much of anything for fear she would have another heart attack. Her quality of life was extremely poor. Out of desperation, her cardiologist referred her for EECP. After completing her EECP treatment, her angina was very rare and quite mild, and she went from taking approximately twelve nitroglycerin tablets per day to taking two, one, or none at all. She was able to walk, sleep, cook, shop, and do just about anything without symptoms. "I am so much better," she said. "I am ready to start exercising again. I feel so good that I'm planning a trip to Italy!"

Just as with exercise, it takes time for EECP's positive effects to emerge, and repetition is the key. The body must recognize that a physiologic change needs to happen, then it must make the change, and then it must incorporate the change into its regular functioning so the benefits will persist. You may know this from your own experience. If you begin to lift weights because you want to strengthen your arms, but you only do so once, what will happen? You will likely be sore and tired the next day, but not stronger. You must lift weights day after day for your muscles to understand that a change is to occur and to respond accordingly. The same rule applies if you want to improve your cardiovascular fitness. If you begin a walking program and walk ten miles, but only once, what will happen? You will likely be sore and tired the next day, but you will not have more stamina or pep. You must engage in aerobic activity *regularly and frequently* for the body to understand that a physiologic change needs to occur and to respond by increasing your stamina. The need for frequent repetition also applies to EECP, the passive form of exercise.

Treatment Schedule

Since the body requires repetition to be trained to function differently, the typical EECP treatment course consists of thirty-five one-hour sessions. This magic number was not chosen randomly; it is based on the clinical research of the last fifteen years and grew out of China's experience with EECP. The Chinese began by providing patients with thirty-six treatments and performing stress tests after every twelve treatments to monitor their progress. Some patients improved after twelve treatments, even more did so after twenty-four treatments, and by the thirty-sixth treatment, EECP's effect had reached a plateau in the majority of patients. Follow-up six months later found that the benefits were sustained and even improved somewhat.[1] Of course, unlike the Chinese, who typically work six days per week, Americans are accustomed to a five-day workweek. To accommodate this schedule when EECP was reintroduced to the United States, the treatment regimen was adapted to one treatment per day, five days per week, for seven weeks. All of the Western clinical studies have been conducted based on this thirty-five-hour schedule, and it has become the standard of care among EECP providers in the Western world.

Doubling up. If you prefer, you may condense the overall length of your EECP program and achieve the same clinical results by taking two treatments per day. If you do opt for a second treatment on any given day, you must take a break of at least one hour between the two sessions. Regardless of the schedule you choose, regularity is the key to success with EECP, so doubling up one day does not mean you may skip your treatment the next day. The more regular you are with your treatments, the better your long-term results will be.

Seeing results. Many patients ask when they can expect to start feeling the treatment's benefits. This is a good question, and it is important for patients to begin their treatment program with realistic expectations. Most patients begin to experience beneficial results from EECP between their fifteenth and twenty-fifth treatments. These benefits include increased stamina, improved sleeping patterns, decreased angina, and less reliance on nitroglycerin and other medications. There is variation, certainly, and some patients start to feel better as soon as their first week of treatment.

Additional treatments. Although all the clinical studies confirm that thirty-five

treatments are essential to achieve benefit with EECP, we must recognize that these studies, like most medical research, were performed in a "perfect world." By this I mean that only patients with narrowly defined coronary artery disease and angina were included. Patients with additional medical problems, scheduling conflicts, and other issues that would inhibit their response to the treatment were excluded. Therefore, while the typical course of treatment is thirty-five sessions, EECP providers around the country agree that, in some circumstances, additional treatments are medically necessary. Additional treatments are most often recommended when an individual's lifestyle is still limited after completing the initial thirty-five treatments and they continue to suffer with chest pain, shortness of breath, fatigue, or other symptoms. I have found that the most common reasons for extending treatment are as follows:

1. While EECP is painless and comfortable, some individuals take more time than others to adjust to the treatment. This prolonged period of adjustment may be due to anxiety or fear of the unknown, other medical problems,

frailty, or low tolerance to the pressure from the cuffs. When this is the case, the patient will require a gradual increase in the length of each treatment and the amount of pressure used until the target sixty-minute treatment time at full pressure (260 mmHg) is achieved. This may take from several days to two weeks, in some cases, and would prolong the overall treatment regimen since the full benefit of the program is obtained from thirty-five one-hour sessions at full pressure. In all the clinical research on EECP, each subject was treated at full pressure for a period of sixty minutes during each of thirty-five treatments, beginning with the first session.

2. Patients with poor leg circulation (peripheral vascular disease) are slower to respond to EECP. Since they have less blood in their legs to begin with, less blood is being pumped back up to their heart with each squeeze of the cuffs. All of the clinical research on EECP has excluded subjects with peripheral vascular disease to ensure that all participants, beginning with the very first treatment, have optimal

blood flow to their heart. Patients with poor peripheral circulation do achieve great results with EECP, but in most cases, they require more than thirty-five treatments. I have found that such individuals need at least fifty treatments to achieve clinical benefit. The first two to three weeks of their program is typically spent improving their leg circulation, and improved cardiac circulation follows.

3. Some patients may complete thirty-five treatments but continue to experience symptoms and limitations due to the advanced stage of their heart disease or their particular physiology. In the clinical research, these individuals were considered "nonresponders" to EECP and were not offered additional treatments. However, in day-to-day clinical practice, our goal is to make *every* patient a "responder." Giving these individuals ten to fifteen additional treatments typically allows them to enjoy EECP's full benefits.
4. Some patients may have a gap in their EECP treatment regimen. Whether due to illness, unexpected travel, or various other circumstances, this inter-

ruption is not recommended because it delays the patient's clinical response. As a result, additional treatments are required to make up for lost time.

A recent study formally documented the benefits of additional EECP treatments beyond the initial thirty-five sessions. It reviewed data on 4,733 patients who were treated at 106 practice sites across the country. Researchers found that 17 percent of the patients received more than thirty-five successive hours of treatment as part of their initial course. Seventeen of the busiest sites reported that more than 30 percent of their patients received more than thirty-five consecutive treatment hours. (This figure is consistent with my practice as well.) In general, the investigators found that patients' results were proportional to the number of EECP treatments they received. They concluded that, while a minimum of thirty-five hours is needed to achieve optimal benefit, even further benefit can be achieved when a patient goes on to have more than thirty-five treatments.[2]

Repeat Procedures

As you know, heart disease is a chronic, progressive illness. Therefore, once patients receive treatment for it, it is possible — even likely — that their symptoms will resurface at some point in the future and require further treatment. Patients and their families are periodically faced with complex decisions about whether and when to undergo repeat treatments, and which treatments are likely to offer the best results. They must weigh potential risks against quality of life concerns and factor in other medical issues that may complicate the situation. They may also be unwilling to undergo additional invasive procedures. All of these considerations make EECP the only treatment option in some cases, and the preferable one in others.

EECP after bypass surgery. Bypass grafts tend to close over time, impairing blood flow to the heart and typically leading to the return of a patient's symptoms. When this occurs, changes in their coronary artery anatomy sometimes make a second operation too technically difficult. Or, patients may have developed other health problems that would preclude them from undergoing a bypass operation again. Individuals who are physi-

cally able to tolerate surgery, but undecided about whether to undergo another bypass, grapple with the reality that the procedure brings twice the risk the second time around. Others, despite being physically able, may simply refuse to have surgery again. Many of my patients have said, "Having open-heart surgery once is more than enough!"

Countless bypass patients fall into one of the above categories, and they may want to consider the alternatives. So the question arises: how does EECP affect patients who have undergone bypass surgery but now have closed bypass grafts? One study, conducted at the State University of New York, Stony Brook, set out to answer this question. It compared twenty-five patients who received EECP after their bypass grafts had closed with thirty-five EECP patients who had never undergone bypass surgery. Catheterizations were performed on all patients prior to starting EECP, and patients were classified by the number of blockages in either their original arteries or their bypass grafts. Patients with one or two narrowed bypass grafts did just as well with EECP as those with one or two blockages in their native arteries (80 to 88 percent success rate). The surprise from

this study was that former bypass patients with three narrowed bypass grafts received as much benefit from EECP as all patients with single- and double-vessel disease, and they enjoyed much greater benefit than those with triple-vessel disease in their native arteries. The bottom line: post-bypass patients usually respond extremely well to EECP, and they can expect the same results as those who have not undergone surgery in the past.[3]

EECP after angioplasty or stent placement. Approximately 30 percent of patients who undergo angioplasty or stent placements find that the targeted blood vessels close again (a process called *restenosis*) within the first six months. As a result, repeat interventions are frequently performed to reopen these narrowed vessels. Sometimes, however, repeat procedures may be prohibited due to scar tissue buildup or certain anatomical changes in the coronary arteries. Or, as is often the case with bypass patients, individuals may refuse to undergo another angioplasty or stent procedure after the first has failed. For this reason, many patients who receive EECP have undergone angioplasty and stent placements at some point in the past. Significant research has examined how

these patients respond to EECP, as compared to those EECP recipients who have not been through such procedures.

In one study from the International EECP Patient Registry at the University of Pittsburgh (Pennsylvania), 3,179 patients who had already undergone and failed to benefit from an angioplasty or stent procedure and turned to EECP as a last resort were compared to 215 patients who were candidates for invasive procedures but instead chose EECP first. The study found that the patients who underwent angioplasty and stent placement first responded to EECP with decreased angina and nitroglycerin use, and their angina improved at a rate similar to the EECP-first patients. Treatment with EECP resulted in sustained, and often progressive, reduction in angina in both groups over the following six months. The authors went one step further, concluding that EECP should be offered as a first-line treatment for heart disease.[4]

Incidentally, when EECP is provided immediately after an angioplasty or stent placement, it reduces the rate of restenosis (blood vessels reclosing) by as much as 30 percent. Therefore, EECP could help improve the success rates and

long-term benefit of these invasive techniques if it was offered to patients immediately following their recovery from the procedure.[5]

EECP after EECP. Patients who receive EECP, just like any other treatment, may need to return for additional courses to address recurrent symptoms. Clinical experience and medical literature widely support the fact that some patients require and respond favorably to repeat courses of EECP. The University of California San Francisco Medical Center recently studied 1,192 patients who underwent a standard thirty-five-hour treatment regimen and found that 18 percent returned for additional treatment within two years. The average length of time before patients returned was just over one year. Reasons for repeating EECP were persistent and/or increasing angina. The repeat regimen was effective: 70 percent experienced a significant decrease in angina and had a corresponding decrease in nitroglycerin use.[6] Other studies echo these findings, confirming that initial and second courses of EECP are similarly effective.[7] Researchers have found that approximately 40 percent of patients treated successfully with EECP will require repeat courses of treatment

within the first three to five years.[8] Medicare and most private insurers pay for additional rounds of EECP.

Case Study

Herb S. had suffered a heart attack and underwent bypass surgery at age thirty-nine, and again at age fifty-one. He was an elite amateur tennis player all of his life, and he was able to return to singles tennis after each of his surgeries with the help of aggressive rehabilitation. At age sixty-three, his angina, which severely limited his activity level, slowly and progressively returned. He was unable to climb one flight of stairs without chest pain, let alone pick up a tennis racket. His cardiologist told him he was not a candidate for additional operations and referred him for EECP instead. Herb did exceptionally well with the treatment. His angina disappeared, and he was able to return to the tennis court for a few volleys. Several months later, he had a mild recurrence of angina and received another round of EECP treatments,

which enabled him to play doubles. A few months after that, Herb again experienced some angina and he went through the program once more. By the time he finished his third round of treatments, he was playing singles tennis again without any problem.

For most patients who return for additional rounds of EECP, the decision is easy. Unlike invasive procedures, there are no concerns about risks or complications. And since the treatment is comfortable and noninvasive, patients do not feel emotional stress or apprehension at the prospect of returning, as they often do with surgery. On the contrary, many look forward to it!

SPECIAL CASES: SUBPOPULATIONS

Not all heart disease sufferers are created alike. Some, such as the elderly and frail, are particularly high risk. Others, such as women, have anatomical considerations that often make them poor candidates for the invasive cardiac procedures commonly offered to men. Here, we will examine how EECP

provides a safe, effective, and welcome treatment option for these groups.

Elderly and Frail Patients

As we saw earlier, the elderly and frail comprise a high-risk and growing population of heart disease sufferers. These individuals respond extremely well to EECP. In one study, I reported on twenty-four of my patients over the age of eighty (their average age was 84.75 years). After EECP, twenty-three (96 percent) experienced reduced symptoms, increased activity level, and improved physical mobility and emotional outlook as a result of the treatment. EECP was found to be a safe treatment for this population; no adverse events were reported.[9] In another study, from the International EECP Patient Registry at the University of Pittsburgh, 249 patients over eighty years of age were assessed immediately after receiving EECP, and again one year later. Immediately following treatment, 76 percent of the participants reported improved ability to perform physical activities and reduced symptoms, and 81 percent of these responders maintained their benefit at the one-year follow-up.[10] These studies are important because they demonstrate that EECP is both effective and harmless in

this population, which is at an increased risk of complication (such as heart attack, death, bleeding, infection, or stroke) from invasive procedures and is more likely to prefer a noninvasive treatment option.

Women versus Men

We know by now that heart disease is not a man's disease. In fact, not only is it the number-one killer of both men and women in the United States, but almost as many women are disabled by the symptoms and limitations arising from heart disease as are men (1.9 million versus 2 million).[11] The numbers are staggering. Of female heart disease sufferers aged fifty-five to sixty-four, 36 percent are disabled by the condition. That number rises to 55 percent among women with heart disease over the age of seventy-five.[12]

Case Study

Irene D., age sixty, underwent a triple bypass operation after suffering a heart attack, but her symptoms returned soon after. "I started feeling so tired. I'd fall asleep on my husband's shoulder in a restaurant. I could pitch a baseball to my grand-

children, but I couldn't run the bases. My former cardiologist said, 'You're almost sixty. You don't need to run the bases.' But I can't be the sick grandma. That's not who I am." After EECP, Irene said, "I'm doing terrific. I'm no longer yawning in my clients' faces. My thinking is so much clearer. People say, 'What are you doing? You look so much better. You're glowing.' The treatment lasted me a year and a half the first time, and then I went back. I decided, if I have to repeat it every two or three years, then I'm going to repeat it every two or three years. I'll tell you what — it beats crackin' my chest."

Treating female heart disease sufferers poses serious challenges for physicians who rely on invasive procedures. First, since women tend to have small arteries, they are often physically unable to undergo angioplasty, stent placement, or bypass surgery. Those who can receive these treatments must reconcile with the facts: women find it much more difficult than men to recover from invasive cardiac pro-

cedures, and their risk of complication is significantly higher. Procedural complications account for half of all deaths resulting from angioplasty and stent placements, and they are a particular problem for women.[13] The disparity between men and women in response to bypass surgery is of equal concern. In addition to having a higher risk of death from bypass surgery than men, women have substantially more challenging and prolonged recovery periods, both physically and mentally. Women are also twice as likely as men to be readmitted to the hospital during their recovery period. And in addition to these risks and difficulties, researchers have found that women's physical and mental functioning is likely to decline, rather than improve, after a bypass.[14]

EECP offers tremendous hope to this population. Women respond to the treatment just as well as men, if not better.[15] In a study by Soran, Kennard, and Feldman, the investigators found that women responded to EECP with the same significant reduction in angina as men, and had even greater improvement in self-assessed health status, quality of life, and lifestyle satisfaction.[16] EECP is an overwhelmingly effective treatment for women, who may

have few other acceptable options to address their heart disease.

SPECIAL CASES: OTHER MEDICAL CONDITIONS

Many heart disease sufferers have other medical concerns that make invasive cardiac procedures too risky or even impossible. For these patients, EECP offers an effective method for treating their heart disease without risk of complication.

Diabetes

Individuals with diabetes are at high risk of developing coronary artery disease. Their blockages are often widespread, located in their smaller arteries, and in remote areas that are technically difficult or even impossible to reach with invasive techniques. Therefore, people with diabetes are often poor candidates for bypass surgery, angioplasty, or stent placement. The good news is that patients with diabetes respond just as well to EECP as patients who do not have diabetes. EECP stimulates healthy, nondiseased vessels throughout the coronary circulation to take over the job of transporting blood to the heart, so the size and location of blockages do not matter. In one study, 658 patients with diabetes

and symptomatic heart disease were treated with EECP and followed over the subsequent year to chart their response. Of these patients, 87 percent had undergone an invasive cardiac procedure prior to receiving EECP and were not candidates for additional surgery. At the completion of their EECP treatment, 69 percent responded favorably, and 72 percent of these individuals had sustained benefit one year later. None of the patients' conditions worsened. In fact, patients enjoyed significant improvement in quality of life as a result of EECP. Despite the fact that individuals with diabetes are considered high-risk patients, the one-year mortality rate among those treated with EECP was equal to that among diabetics who undergo surgery.[17]

These exciting results have enormous implications. Nearly 20 million Americans — 9.5 percent of the population — have diabetes. A recent study found that men born in the United States in 2000 have a 32.8 percent probability of being diagnosed with diabetes at some point in their lives. For women, the likelihood is even higher: 38.5 percent.[18] Accordingly, the number of cardiac patients with diabetes is growing dramatically, and the need for an

effective treatment such as EECP for this subpopulation is dire.

Congestive Heart Failure

Physicians are extremely interested in how EECP may be used with patients who have congestive heart failure (CHF). In these individuals, the heart's ability to pump is impaired. The condition can be caused by a severe heart attack, a series of small heart attacks, a virus, toxins such as excessive alcohol in the body, long-standing hypertension, or untreated valve disease. Heart failure is measured by ejection fraction: the ratio of blood that is pumped out with each beat of the heart to the volume of blood that fills the heart between beats. A normal ejection fraction is 50 percent or more, meaning that a healthy heart pumps at least half of the blood that enters during its resting phase back out to the body when it contracts. A heart that is unable to produce an ejection fraction of 50 percent is impaired. The lower the ejection fraction, the weaker the heart muscle, and the less blood it can pump out to the body. The less blood the heart is able to pump, the more blood will accumulate in the lungs and the rest of the body, and the more severe the related symptoms of shortness of breath,

swelling in the legs, and fatigue will be. In most cases, patients who develop heart failure symptoms have ejection fractions below 35 percent.

EECP is standard therapy for heart failure in China, and the body of evidence in the United States to support this practice continues to grow. When we look at end-stage, refractory (unable to have surgery and on maximum medications) angina patients who are treated with EECP, those with ejection fractions below 35 percent are sicker to begin with than those with higher ejection fractions. Several studies — most originating from the University of Pittsburgh's groundbreaking work — have shown that EECP is safe, improves quality of life, decreases symptoms, and improves exercise tolerance in even the sickest congestive heart failure patients. Those with congestive heart failure not only show immediate improvement with EECP, but two-thirds remain event free (that is, no heart attacks, hospitalizations, or procedures) and continue to have decreased angina six months after the program.[19]

Patients with congestive heart failure only, and no angina symptoms, also respond favorably to EECP. The treatment

does not aggravate the condition; in fact, just the opposite is true. In one study, five congestive heart failure patients underwent a standard course of EECP — thirty-five treatment hours over seven weeks. At the end, their heart's working capacity improved by an average of 19 percent. The length of time they were able to exercise increased by 34 percent, and their quality of life and ability to function also significantly improved.[20]

Another study, with twenty-six congestive heart failure patients, found similar results. Patients saw a 21 percent improvement in exercise duration after their treatment, and they maintained a 16 percent increase six months later. Their overall cardiovascular fitness improved by 7 percent at the end of the program, and they showed an even further improvement of 27 percent six months later. Quality of life also improved throughout the follow-up period. Again, EECP did not cause any adverse events during the program or during the six months that followed.[21]

In addition to improving exercise capacity and quality of life in congestive heart failure patients, EECP strengthens the heart muscle itself. Since congestive heart failure is a condition where the heart

muscle is weak and unable to pump all of the needed blood out to the body with each beat, the heart must beat faster to compensate. Achieving a slower heart rate in these individuals would indicate that their heart has grown strong enough to get its job done in fewer beats per minute. The lower the heart rate, the lower the heart's workload and stress level. EECP reduces the heart rate in congestive heart failure sufferers. In one study, EECP improved ejection fraction by 16 percent, increased overall heart muscle power by 28 percent, and decreased patients' heart rate by 11 percent.[22] These results — which lasted for at least six months after the treatment was completed — powerfully demonstrate that EECP not only enhances circulation, as in people with coronary artery disease, but also directly improves the condition of heart failure by making the heart muscle itself stronger and better able to function.

EECP has been shown to improve congestive heart failure in another way. Because the heart muscle is weak in these patients, blood does not circulate as it should. As a result, fluid often accumulates in the body, and it manifests as swelling in the legs and shortness of breath. The

heart detects this excess fluid, and then tries to get rid of it by producing diuretic hormones, such as plasma brain natriuretic peptide (BNP), to stimulate the kidneys. EECP reduces BNP levels by as much as 14 percent, indicating that it improves fluid balance and heart muscle performance, and ultimately reduces swelling in the legs and shortness of breath.[23]

The FDA responded to the above studies, which proved EECP's safety and ability specifically to treat congestive heart failure, by approving EECP as a treatment for heart failure in July 2002. This landmark event promises to open a whole new world to the nearly five million Americans living with heart failure. Before the FDA's move, heart failure patients could only manage their condition by carefully balancing their medications, modifying their diet, curbing salt intake, and regulating their beverage consumption. Now, however, a physical treatment exists that can help congestive heart failure patients reduce their difficult symptoms. Because no invasive or surgical treatments exist for this condition, the medical community is expected to embrace the use of EECP as a treatment for heart failure much more rapidly than it has for angina.

Microvascular Angina and Cardiac Syndrome X

Approximately one-third of patients with angina have normal coronary angiograms, meaning none of their major coronary arteries are more than 70 percent blocked.[24] However, the fact that these individuals have symptoms indicates that blood flow to their heart must be impaired. It is assumed, therefore, that their blockages are located in microscopic vessels — too small to be visible on a catheterization — and they are given the diagnosis of *microvascular angina*. When an abnormal stress test confirms that blood flow to the heart is impaired, the condition is called *cardiac syndrome X*. Often, the two terms are used interchangeably.

Historically, patients with microvascular angina or cardiac syndrome X were not considered to be at significant risk of heart attacks or other dangerous outcomes, so the condition has not received tremendous attention. More recently, though, researchers have found evidence to contradict conventional thought. A large study found that 10 percent of women and 6 percent of men who go to the hospital during a heart attack have no significant blockages. The study confirmed that individuals

with microvascular angina are, in fact, at significant risk of major cardiac events and that the condition is a serious one, which must be treated effectively.[25] However, because microvascular angina patients have no substantial, accessible blockages, surgical or invasive procedures are not suitable treatment approaches for them. Instead, physicians rely heavily on medications to treat this condition, achieving only marginal results.

EECP offers hope to such patients, who often feel hopeless. One study examined the benefits of EECP in twenty-one microvascular angina patients (fourteen women and seven men). After completing their course of EECP, all of the patients had a marked reduction in angina, and twenty (95 percent) maintained that improvement during the following year. Five months after their treatment, sixteen out of seventeen patients (94 percent) who underwent a stress test found that blood flow to their heart was completely normal.[26] This study provides encouraging evidence that EECP is an effective tool for another class of heart disease patients that has very few treatment options.

It is common for individuals living with HIV and AIDS to have high cholesterol and elevated blood sugar levels (a signal of early onset of diabetes). Both are well-known risk factors for heart disease. As a result, a large study recently examined the risk of heart attack among these patients. The investigation revealed that the longer HIV-infected men are treated with anti-AIDS drugs (specifically protease inhibitors such as Crixivan or Viracept), the more likely they are to have a heart attack. Among patients who had been taking a protease inhibitor for fewer than eighteen months, the rate was 8.2 heart attacks per ten thousand people annually. The rate nearly doubled to 15.9 per ten thousand among those treated for eighteen to twenty-nine months, and more than doubled again to 33.8 among patients who had been on the drugs for thirty months or more. By comparison, the expected annual heart attack rate in the general population of similarly aged men is 10.8 per ten thousand people. HIV-positive men who have been treated with protease inhibitors for eighteen to twenty-nine months, then, have a 50 percent higher risk of suffering a heart attack than their healthy counterparts, and their increased risk jumps

to more than 300 percent if they are treated for thirty months or more.[27] In short, these individuals face an unavoidable double-edged sword: their lifesaving medications enable them to live longer, but the drugs also put them at much higher risk for developing heart disease. Obviously, a noninvasive and effective treatment is ideal for this high-risk population. That treatment is EECP.

Lupus

Systemic lupus erythematosus (commonly referred to as lupus or SLE) is a chronic inflammatory autoimmune disease that primarily targets young women, a group largely unaffected by heart disease. Treatments for lupus have improved in recent years, and long-term survival rates have increased. However, many people with lupus develop heart disease at a comparatively young age and have substantially increased rates of death and disability from cardiovascular disease relative to the general population.[28] Individuals with lupus are five times more likely to have a heart attack than healthy people of the same age. In young women, that rate increases by a factor of as much as fifty.[29]

The reasons for this population's higher

susceptibility to heart disease are poorly understood. Traditional risk factors for coronary artery disease such as high cholesterol, smoking, and high blood pressure are not likely to blame. It is possible that the chronic inflammation that characterizes the condition, or even the drugs used to control it, plays a role. Once again, we find evidence of inflammation's function in causing disease. In this case, it may form the link between lupus and heart disease.

How does EECP fit in here? Several considerations indicate that a noninvasive method would be preferable in treating heart disease among lupus sufferers. First, patients with lupus are at high risk for developing kidney dysfunction. As such, what might normally be considered a "routine" cardiac catheterization, which involves injecting dye into the patient to locate blockages, could easily result in complete kidney failure in a patient with lupus, necessitating dialysis. Second, lupus patients have a higher risk of suffering a stroke, making any invasive cardiac procedure more dangerous. Third, since many individuals with lupus are women, they are likely to have small blood vessels and have lower success rates after bypass sur-

gery than men. And fourth, healing from any invasive procedure when you have a chronic illness and are taking immunosuppressive medications is much more difficult and prolonged than it would be otherwise. Immunosuppressive drugs slow the healing process in general, so even a catheterization poses significant risk. These drugs also greatly increase patients' risk of developing potentially deadly post-procedure or postoperative infections. In this population, therefore, it is particularly illogical and risky to use localized, invasive techniques like bypass surgery and angioplasty that target individual blockages. With all of these factors in mind, it becomes clear that EECP, a noninvasive and remarkably effective treatment, is the best method to treat heart disease in this complicated, high-risk group.

Rheumatoid Arthritis

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune condition that affects approximately 1 percent of the United States population. About 75 percent of rheumatoid arthritis sufferers are women. Patients typically experience pain, swelling, limits on their mobility, and deformity in multiple joints, especially the hands, wrists,

knees, and feet. Individuals with rheumatoid arthritis have disproportionately high rates of heart disease, and their increased risk often exists long before they are diagnosed with rheumatoid arthritis. A recent study found that during the two years before their rheumatoid arthritis diagnosis, patients were three times more likely to have been hospitalized for a heart attack and five times more likely to have had an unrecognized ("silent") heart attack. After their diagnosis, patients with rheumatoid arthritis are twice as likely to experience silent heart attacks and sudden cardiac death. The link between rheumatoid arthritis and heart disease suggests that the two illnesses likely have the same origin; scientists suspect that they are both traced to inflammation.[30] Individuals with rheumatoid arthritis also have twice the risk of developing congestive heart failure over their lifetime than those who do not have rheumatoid arthritis.[31]

The key to understanding why individuals with rheumatoid arthritis have a relatively high rate of silent heart attacks and delayed heart disease diagnosis may lie in the fact that most are women. Women, as we have discussed, tend not to experience chest pain — the primary symptom most

people associate with heart disease. Therefore, they may not recognize the warning signs as such, increasing the likelihood that a heart attack will unexpectedly occur or go unrecognized. The increased rates may also have to do with the painkilling medications that many rheumatoid arthritis patients take to manage their condition, which may mask painful heart disease symptoms.

EECP is an excellent treatment option for cardiac patients with rheumatoid arthritis, for a variety of reasons. First, as many rheumatoid arthritis patients are women, their blood vessels tend to be small, often making invasive procedures difficult or impossible. Second, rheumatoid arthritis may affect not just the joints, but the lungs, kidneys, skin, nerves, and other organs as well. As a result, individuals with the condition tend to be medically complex, placing them at significantly higher risk of surgical complications than the average patient. And since these patients are often on immunosuppressive drugs, just like lupus patients, they are at substantially higher risk for developing devastating infections from invasive procedures of any kind. Third, patients with chronic illnesses such as rheumatoid ar-

thritis tend to be frail. Therefore, they are likely to be much weaker after surgery and experience significantly longer and more complicated recovery periods than average patients. Each of these factors makes a noninvasive treatment preferable for this population.

In addition to it being the most appropriate treatment for a host of reasons, EECP offers patients with rheumatoid arthritis a remarkable side benefit. By improving the flow of much-needed blood to affected joints, EECP not only aids mobility, it reduces joint pain as well.

BOOSTING BLOOD FLOW

EECP is effective in treating heart disease and the many subpopulations of patients with special needs and considerations because it strengthens circulation, noninvasively and without risk. As a result, patients are able to effortlessly integrate the treatment into their lives and begin to enjoy its benefits almost immediately. However, heart disease is only one of many conditions marked by poor blood flow. Since EECP boosts blood flow not only to the heart but throughout the body, it can be a valuable tool in treating, managing, and even preventing numerous ailments rooted in poor

circulation. In the next chapter, we will review some of the noncardiac diseases and conditions that can be addressed more safely, more easily, and less expensively with EECP, and we will examine the treatment's ability to enhance athletic performance in healthy people.

5

THE POSSIBILITIES ARE ENDLESS

EECP's Benefits beyond Heart Disease

Since EECP stimulates the blood flow that is so crucial to good health, it is natural to think it can be useful in treating a variety of other health problems that have poor blood flow as a root cause, and even offer a boost to athletes looking for an edge. As I mentioned earlier, China routinely uses EECP to treat numerous non-cardiac conditions with tremendous success. Indeed, research has been and continues to be conducted throughout the world on EECP's effect on a wide variety of ailments. In my own practice, I am constantly awed by the extent to which my patients experience improvement in their noncardiac medical conditions as a side benefit of EECP. In this chapter, we will look at a sampling of EECP's many noncardiac benefits.

EECP AND THE AILING BODY

EECP can benefit people with a wide variety of ailments, from hearing and visual disorders to diabetes, and from Alzheimer's disease and Parkinson's disease to arthritis. By aiding blood flow, EECP brings unexpected healing and comfort to many people.

Stroke

A stroke is essentially a "heart attack of the brain." It is most commonly caused by a sudden blockage of an artery in the brain, just as a heart attack is the result of a sudden blockage of an artery in the heart. These types of strokes are called *ischemic*, meaning they are caused by a lack of blood and oxygen delivery.

EECP improves blood flow to the brain. Accordingly, Chinese physicians have integrated EECP into their routine rehabilitation of recent ischemic stroke survivors. These patients recover faster and more completely than stroke survivors who do not receive EECP, thanks to the improved blood flow to the brain that EECP provides. Anecdotal reports indicate the treatment may even benefit patients who suffered a stroke years earlier.

Alzheimer's Disease

Many types of dementia are thought to be the result of poor blood flow to the parts of the brain responsible for cognitive abilities. In one study, conducted at Nanfang Hospital in China, patients with dementia related to Alzheimer's disease who were treated with EECP experienced an increase in blood flow to the brain as well as an increase in biological markers related to thinking and memory.[1] These exciting findings suggest that EECP may offer hope for Alzheimer's sufferers. Indeed, many of my patients have reported that they could think more clearly and remember more accurately after completing their treatment program. One patient, a vascular surgeon, told me he found it much easier to remember details about his patients without referring to their charts after his course of EECP. There is no doubt that we are on to something here, which is why more research on the effects of EECP on moderate and severe dementia is currently underway.

Case Study

Anna K., age seventy-six, had angina, heart failure, peripheral vascular disease, and diabetes. In addition, she had suffered two strokes several years earlier, leaving her unsteady on her feet and dependent on a walker. As she progressed through the EECP program, her fatigue and shortness of breath steadily improved, and she also noted that her sense of balance was returning. On the day of her twenty-eighth EECP treatment, she walked into my office using only a cane. It was the first time in years she had been able to leave home without her walker!

Case Study

William R., age seventy-five, was a semiretired engineer who still conducted research. However, he had experienced progressive cognitive decline in recent years. When he first started his EECP program to treat his angina and congestive heart failure, his wife had to accompany him in the car because he had trouble re-

membering the way to the office. Halfway through his seven-week course of treatment, he was able to drive alone without any difficulties. By the end of the program, he noted improved clarity of thought. He was able to perform mathematical computations more quickly and accurately, and he had become significantly more productive in his research.

Case Study

Norm B., age seventy-five, had long-standing coronary artery disease and heart failure, had suffered multiple heart attacks, had undergone bypass surgery, and had a pacemaker. He experienced severe shortness of breath with minimal exertion, and he had chest pain when carrying packages, climbing steps, and breathing cold air. In addition, Norm had chronic deafness in his left ear. As he progressed through the EECP program, in addition to his chest pain subsiding, shortness of breath diminishing, and

energy improving, he noted that he could hear in his left ear for the first time in nearly twenty years.

Hearing Disorders and Tinnitus

Lack of blood flow to the sensory systems in the ears is thought to cause hearing disorders and tinnitus (persistent ringing in the ears). In Germany, the standard therapy for sudden deafness and tinnitus involves medications designed to improve blood flow to the inner ear. Not surprisingly, these disorders have also been shown to improve with EECP. In one study, thirty patients with acute hearing disorders and or tinnitus that persisted despite standard drug therapy received five to ten one-hour EECP treatments. Blood flow to the brain via the internal carotid artery (feeding the front of the brain) improved by 19 percent and via the vertebral artery (feeding the back of the brain) by 11 percent. Tinnitus significantly decreased in 47 percent of the patients, and the hearing threshold markedly increased in 28 percent. Hearing tests (audiometry studies) conducted after the study demonstrated that the improvement persisted throughout a one-year follow-up period.[2]

In a Chinese study, EECP used in combination with traditional Chinese and Western medicines was found to improve deafness after only thirteen treatments in 75 percent of cases (versus 55 percent in patients treated with medications alone). Just 17 percent (versus 33 percent) of patients experienced a recurrence in deafness in the three years following the study.[3]

Visual Disorders

Severe narrowing (atherosclerosis) of the ophthalmic arteries, which bring blood to the eyes, can result in vision impairment. Any improvement in their function or in the function of retinal vessels is likely to result in better vision. EECP has been found to improve blood flow to the eyes, particularly to the retina. A study from Friedrich Alexander University in Erlangen, Germany, involving patients with severe atherosclerosis in the ophthalmic arteries showed that EECP increased diastolic blood flow velocity in these arteries by 21 percent and overall blood flow velocity in the arteries by 11 percent. No change in blood flow to the eyes was found in patients with normal ophthalmic arteries, providing a powerful illustration of the body's inherent safety mechanisms to protect organs

from too much blood flow.[4] Clearly, the future holds promise for other visual disorders where blood flow plays a role, such as macular degeneration and diabetic retinopathy. As the case studies describe, we already have abundant anecdotal evidence of EECP's ability to improve these conditions.

Case Study

In addition to chronic angina, Franklin S., age sixty-seven, had diabetic retinopathy. EECP not only greatly reduced the severity of his angina, restored his energy, and enabled him to exercise again (he could swim for forty-five minutes without chest pain), it also improved his vision.

Case Study

Mitchell C., age fifty-seven, had diabetes, hypertension, congestive heart failure, and peripheral vascular disease. Despite undergoing bypass surgery and several angioplasties and stent procedures, he continued to experience chronic an-

gina. After completing his EECP program, he had much less angina, significantly more energy, and was able to engage in more activities in and out of the house. But he was most excited about his improved vision as a result of EECP. For the first time in years, he no longer needed his glasses for reading or for driving.

Parkinson's Disease

Anecdotal reports also provide encouraging news about EECP's ability to improve symptoms associated with Parkinson's disease. Lack of blood flow to the part of the brain that makes dopamine, the key chemical that is lacking in patients with Parkinson's disease, is a major contributing factor to the condition. Parkinson's patients have responded to EECP with a reduction in tremor, improvement in their balance and ability to walk, and improvement in their facial expressions. These benefits have been reported to last for as long as two years.[5]

Erectile Dysfunction

Erectile dysfunction (ED) is a condition that severely compromises quality of life for

many men living with heart disease. It is most commonly a result of a lack of blood flow to the penis. While there are medications for erectile dysfunction, most men with heart disease are unable to take them because of the risk of serious side effects when they are taken in combination with cardiac medications. EECP may very well be the long-sought-after solution to this often devastating problem. In a study conducted at Technical University in Dresden, Germany, men reported significant improvement in penile rigidity and erectile function after completing only twenty EECP treatments. Their experience corresponded to measured improvement in blood flow to the penis. Perceived quality of erection improved by nearly 100 percent, and there were no negative side effects." Many of my male patients remark about this unexpected and welcome benefit of EECP. One patient asked, "Doc, is this normal? I feel like a twenty-year-old again!"

Chronic Wounds

In order for the body to heal a wound, it must deliver blood to the affected skin and underlying tissue. Blood delivers the needed cells and chemicals that fight infection and supply nutrients, oxygen, and the

building blocks of healthy tissue to the wound. Remember, EECP increases blood flow throughout the body, including the skin.[7] So it is not surprising that EECP, by improving circulation to wounded areas, promotes healing. I have observed this many times in my practice, and it is always a thrilling side benefit of the treatment for patients who are struggling with chronic wounds.

Case Study

Charles B., age sixty-nine, had non-healing ulcers on his left leg for thirty-one years — a complication of a trauma and orthopedic surgery. He would get angina after eating, doing household activities, and climbing steps. He had multiple stents placed after a heart attack, but he continued to have angina that forced him to limit his activities. After receiving EECP, he had no angina and was able to engage in increasingly demanding physical activities without limitation. As a side benefit of EECP, he was able to get so much blood flowing in his leg that his ulcer began to bleed, and he was finally

able to undergo a skin graft. Recently he said, "I am walking without pain for the first time in more than thirty years, and I owe it all to EECP."

Peripheral Vascular Disease

In addition to heart disease, many of my patients suffer from poor circulation in their legs, a condition called *peripheral vascular disease*, or PVD. This is not surprising, since the same disease that affects the arteries of the heart affects the arteries in the legs. In fact, although they are heart patients, those who also suffer with peripheral vascular disease often primarily complain of poor leg circulation and leg pain, known as *claudication*. This leg pain is "angina in the legs," as the legs cry out for more blood, and it can be so severe that it limits patients' ability to walk, rendering them essentially inactive. While many sufferers undergo bypass surgery, angioplasties, and stent placements in their legs to treat the condition, the debilitating claudication often returns.

It is incorrect to conclude that patients with peripheral vascular disease do not have enough blood flowing in their legs to benefit from EECP. On the contrary, that

is exactly why they need the treatment. The journey these patients typically take during their EECP program is fascinating. As a matter of course, the procedure improves their leg circulation, enabling them to walk more and do more before pain sets in. As their activity level climbs, their heart disease–related symptoms — which had been masked by their inactivity — reemerge. Continued EECP treatments improve blood flow to their hearts as well as to their legs, their angina begins to subside, and they finally return to the lifestyle they have been missing for years.

Based on the impressive results I, and EECP providers across the country, have seen in so many peripheral vascular disease sufferers, I predict that EECP will become an approved treatment specifically for peripheral vascular disease in the very near future.

Diabetes

Diabetes is a major risk factor for heart disease, so it is not surprising that many of my patients suffer from the condition. In addition to the obvious benefits of improved heart and leg circulation that EECP brings to these patients, I am continually struck by another positive side effect that individuals

with diabetes often enjoy: improved blood sugar control. This is a logical effect, when you consider that blood flow helps determine the body's ability to utilize sugar. As increased blood flow reaches the pancreas, insulin production is enhanced, thus improving overall blood sugar control. Since the cornerstone of successful long-term diabetes management is tight blood sugar control, adding EECP to the scope of treatments used to fight the growing epidemic of diabetes in this country is urgently needed. Much research is currently underway in this area.

Peripheral Neuropathy

Peripheral neuropathy is a condition that results in pain and numbness in the feet, legs, and hands. Typically, a patient suffering from peripheral neuropathy will lose most, if not all, of their sensation in these areas, which means they cannot feel, distinguish temperature, or recognize the location of their extremities in space with their eyes closed. This devastating condition is frequently due to a lack of blood flow to the tiny nerves responsible for sensations. EECP stimulates more blood to flow to the affected nerves, improving their function, reducing related symptoms, and offering

another major quality of life benefit of the treatment.

Case Study

Bernice J., age seventy-seven, had diabetes and a thirty-year history of heart disease and angina. She had suffered three heart attacks and had angioplasty. She was not able to undergo bypass surgery due to her small vessels. At age sixty-one, because of her severe circulatory problems, both of her legs were amputated below the knee. But until her most recent heart attack, she could walk independently on two prostheses. Her third heart attack had a profound effect on her condition, leaving her without enough stamina to even stand, let alone walk. After her EECP treatment, her angina disappeared, her energy and stamina returned, and she was once again able to walk independently on her prostheses.

Case Study

Mariya G., age seventy-four, had angina and a history of heart attack, bypass surgery, congestive heart failure, and peripheral vascular disease. She also had suffered from diabetes for fifteen years, requiring insulin injections for the last several years to adequately control her blood sugar. After completing fifty EECP treatments, Mariya's chest pain and shortness of breath disappeared, and her stamina was greatly increased. In addition, her blood sugar control improved markedly, allowing her to completely discontinue using insulin and to control her diabetes with diet and oral medications alone.

Case Study

Michael T., age sixty-seven, had diabetes and severe peripheral neuropathy in addition to coronary artery disease and angina. As he progressed through his EECP program, he said, "I started getting more feeling in my toes. Also, my hands, feet, and body

are now warm. Wow! I can now work or be on my feet for hours! I have lots more pep and stamina, and I can do more and walk farther without getting out of breath."

Case Study

Prior to starting EECP, Charles L., age eighty-four, was having angina approximately ten times per week with basic activities. After EECP, his angina was eliminated, and he was able to exercise, climb steps, and engage in all daily activities without difficulty. Nearly two years after completing his EECP treatment, this engineer and author told me, "I am having the time of my life. I am happy and feel good all the time. My memory of names has improved, and my mind is sharper than it has ever been. I'm doing original think-tank work again! I now walk two miles, every other day, in forty minutes. I have not experienced any angina or used any nitro tabs. I am having a ball!"

Sleep Cycle and Thought Clarity

Healthy sleep patterns are critical to overall health and well-being. Adequate sleep brings increased energy and improved mood, memory, and clarity of thought. Many heart disease sufferers experience disturbed sleep patterns for one reason or another. One of the earliest benefits that EECP patients consistently report is the ability to sleep better, and they enjoy all the positive ripple effects that brings.

Arthritis

Many chronic pain conditions, such as rheumatoid arthritis, Lyme disease, and low back pain, also respond well to EECP. I once had a patient who suffered from rheumatoid arthritis with severe hand deformities. At the completion of his EECP program, he told me his hands were pain free for the first time in twenty years! Another patient with arthritis related to Lyme disease remarked that, thanks to EECP, she could wake up and walk without hip or knee pain for the first time since her diagnosis. I have had similar conversations with patients who had chronic neck, shoulder, and back pain. Again, it makes perfect sense, and it comes down to the enhanced blood flow that EECP creates. By

improving blood flow, the chemicals responsible for transmitting pain signals in your nervous system are washed away, and you are able to move your joints more freely without discomfort. The more you can move around and exercise, the more your blood flows and the better you feel.

Restless Legs Syndrome

Restless legs syndrome (RLS) is a neurological disorder that sends extremely uncomfortable sensations down the legs, causing people who live with the condition to move their legs frequently in an effort to find relief. These individuals most often suffer symptoms in the evening, as they attempt to relax or sleep. The disrupted sleep that results from constantly trying to "shake off" the intrusive condition can lead to severe fatigue, which eventually impairs daily functioning and quality of life.

The cause of restless legs syndrome is not clear, but blood flow is thought to play a key role, and that is where EECP comes in. One study followed six patients who suffered from restless legs syndrome for many years, in some cases since childhood. Immediately after completing thirty-five EECP treatments, their restless legs syndrome symptoms improved by nearly 80

percent. Three patients, including one with a nine-year history and another with a twenty-three-year history of frequent and disruptive restless legs syndrome, maintained the improvement for three to six months after completing EECP. Two others enjoyed sustained improvement for a full year.[8] These are astounding and significant results for an ailment that has very few, if any, effective treatment options. Clearly, EECP's ability to improve blood flow in the central and peripheral nervous systems and in the legs is what lies behind its remarkable success in treating this condition.

Case Study

Sara D., age sixty-nine, had struggled with restless legs syndrome for many years. The condition prevented her from sleeping more than two hours per night. She received EECP treatment for her angina and congestive heart failure. At the completion of EECP, not only was her angina greatly reduced, her restless legs syndrome had substantially improved. She had fewer cramps and less discomfort, allowing her to sleep much better.

At this moment, researchers around the globe are continuing to work to expand EECP's applications. Because it is safe, noninvasive, comfortable, and inexpensive, we should certainly use it to treat everything we can. Ten years from now (but hopefully sooner), this chapter will be much, much longer, as we discover even more uses for EECP.

EECP AND THE HEALTHY BODY

How does EECP affect a healthy body? I'm sure you have already considered this question. If EECP, by stimulating blood flow, can get even the sickest heart patients moving again and alleviate countless other circulatory conditions, what are the possibilities for healthy people? Sure enough, many researchers and athletes have already taken notice of the astounding effects the treatment has on the healthy population.

For individuals who are too ill or unable to exercise, EECP gives them the next best thing: passive exercise. They simply lie down and rest for an hour while the machine exercises their circulation for them. EECP's effect on the body is similar to that of endurance training: it enables the major arteries in the heart, limbs, and throughout the body to function better

and become more efficient at delivering blood, oxygen, and nutrients.[9] For this reason, some consider EECP to be the exercise for those who cannot exercise. But, since everyone can benefit from the treatment's positive effects, I consider EECP to be the exercise for everyone. For individuals who can and do exercise, whether they are leisure walkers or Olympic athletes, EECP stimulates additional blood flow, further strengthening their cardiovascular system and enhancing their health, stamina, and physical potential in the process. Fundamentally, EECP propels people to the next fitness level, no matter what level they are on. In this section, we will explore exactly what EECP does to your body that creates such healthful effects.

Remember, with EECP, blood pressure cuffs are wrapped around your legs, squeezing and releasing in sync with your heartbeat. As you consider this, you will quickly realize that EECP does not just increase blood flow to your heart, but throughout your entire body. With greater blood flow, your blood vessels grow and strengthen, and new ones develop. Your organs, in turn, get more oxygen and nutrients, and more waste is removed from

your cells. The benefits of this action are endless.

Training the Heart

EECP increases, or augments, diastolic blood pressure — a measure of the blood flow to the heart while the heart is resting, between beats. This augmentation is as great as 93 percent in the aorta (the main artery in the body) and as much as 16 percent in the coronary arteries, and it leads to an overall increase in blood flow to the heart of at least 28 percent.[10] With increased blood flow to the heart, cardiac output is increased. In other words, the heart is able to squeeze more blood out to the body with each beat. At the same time, EECP decreases systolic blood pressure — a measure of how hard the heart has to work to pump blood out to the rest of the body — by 15 percent.[11] In other words, EECP makes the heart's job of delivering blood throughout the body 15 percent easier.

What might this mean to a healthy person? As EECP improves blood flow and oxygen delivery to the heart and reduces the heart's workload, it trains the heart to work more efficiently, similar to the effect of endurance training. An indi-

vidual's fitness level is measured by the amount of oxygen that can be transported from the heart, throughout the body, and to the working muscles, and the efficiency with which the muscles can use this oxygen. This measure translates into the ability to perform more physical activity with less exertion. For example, let us assume that you can run one mile in twelve minutes. Adding EECP to your exercise regimen may enable you to run the same mile in, say, eight minutes if you wish, with ease.

Maintaining Healthy Blood Vessels

In addition to its direct effects on the heart muscle, EECP actually improves overall circulation.[12] Recall what we said earlier about blood vessels, which are dynamic organs, not inanimate tubes or pipes. When blood vessels are healthy, they expand and contract, actively working to deliver blood and oxygen throughout your body and to remove waste products. The healthier your blood vessels are, the better they are able to do their job, and the healthier you are. But just as muscles may weaken and atrophy if they are not exercised, blood vessels may stop functioning properly if poor blood flow leaves them underutilized. The

health of your endothelial cells, the special cells that line the blood vessel walls, determines whether your blood vessels will be alive, dynamic, and healthy. Endothelial cells must be able to dilate and constrict in order for blood vessels to do the same. Individuals with abnormal endothelial cell function will have poorly functioning blood vessels and are more likely to develop circulatory complications such as heart disease.

As you might have guessed, increasing blood flow through your blood vessels is the only way to create shear stress (friction) along the endothelial cells and keep them alive and healthy. This gets to the heart of why blood flow is critically necessary to keep you alive and healthy. Exercise is one way to increase blood flow, and, of course, EECP is another and creates the same healthful effects. EECP has been shown to improve and even normalize endothelial cell function in heart patients, proof of its ability to create physiologic changes that lead to positive, long-term results.[13] If EECP can have this effect on heart disease sufferers, whose endothelial cells are already compromised, it is exciting to consider the treatment's effect on blood vessel functioning in healthy people. Indeed, researchers have con-

firmed that, in addition to enhancing blood flow in and around the heart, EECP strengthens the circulatory system in healthy people. The treatment increases pulsatility, which is an important measure of blood vessels' health and responsiveness to blood flow and plays a critical role in maintaining normal endothelial function.[14] Just as there is no such thing as too much blood flow, there is no such thing as circulation that is too strong or a body that is too healthy.

Detoxifying the Body

EECP also has a profound effect on two organs responsible for ridding the body of waste products: the kidneys and the liver.

The kidneys are the body's filters. As blood passes through them, the kidneys remove waste products by creating urine, and they regulate the balance of salt and water in the body. So, the more blood that flows through the kidneys, the greater the amount of waste the body will be able to eliminate. EECP increases renal blood flow (blood flow to the kidneys) by 21 percent, increases urine production by 60 percent, and nearly doubles salt excretion. EECP decreases renin, a hormone produced in the kidneys that causes the body

to retain salt and water, by 37 percent. With lower renin levels, blood pressure is decreased and more effectively controlled. In short, EECP increases blood flow to the kidneys, improves the kidneys' ability to produce urine, promotes salt excretion, and reduces renin.[15] While our focus here is on healthy people, anyone who receives the treatment will enjoy its natural detoxifying effects.

The liver has three major functions. First, it breaks down a variety of cellular waste products, medications, and other substances in the blood that might be harmful to your body if not filtered out, and it delivers them to the kidneys or the intestine to be eliminated. Second, the liver helps process food into proteins and other substances that your body needs for nourishment. For example, it makes bile, which breaks up fats and allows you to absorb vitamins such as A, D, and E from the foods you eat. Third, the liver acts as a storage place for sugars and vitamins (especially vitamin B_{12}) and releases them when you need them. The liver can only perform these critical jobs when it receives sufficient blood flow. The more blood flow it receives, the more thoroughly and efficiently the liver is able to help detoxify

your body. EECP aids the liver by increasing its blood flow by as much as 25 percent.[16]

Boosting Antioxidants

There is a furnace called the *mitochondria* within every cell of your body. As the mitochondria utilizes oxygen to create energy during normal cellular metabolism, a charged oxygen molecule called a *free radical* is occasionally created. This molecule has at least one unpaired electron in its outer orbit, giving it a negative electrical charge and enabling it to damage cell membranes, vessel walls, proteins, fats, and even DNA. If the free radical is not quickly neutralized, it can go on to create new ones that are just as dangerous. Your body uses its stores of natural antioxidants to neutralize free radicals, but if its supply is not great enough, the free radicals will dominate, and oxidative stress will occur. When oxidative stress persists over a long period of time, your body will likely develop a chronic degenerative disease. It is this type of progressive damage that has implicated free radicals as an underlying cause of premature aging and many chronic diseases and conditions, including heart attacks, strokes, diabetes, cancer, arthritis,

Alzheimer's disease and dementia, macular degeneration, lupus, fibromyalgia, chronic fatigue, and more. Oxidative stress and free radicals also damage the cholesterol molecule, making it more likely to layer out in your arteries as plaque. People with heart disease, for example, experience higher levels of free radical production and oxidative stress than healthy individuals. In other words, their antioxidant defenses are impaired.

In order for your body to use natural antioxidants to attack free radicals, neutralize them, and render them harmless before they can wreak havoc, it must have enough antioxidants to match the number of free radicals your body produces. Unfortunately, as we age, our natural stores of antioxidants diminish, which is why physicians, nutritionists, fitness experts, and antiaging specialists so often recommend that we take oral supplements or eat foods rich in antioxidants to boost our reserves.

While EECP is a physical treatment, it also has proven antioxidant effects. Malondialdehyde is a substance that is created when cell membranes are damaged by oxidative stress. Vitamin E, a potent antioxidant, decreases malondialdehyde levels by a chemical reaction. EECP also causes

a steady decrease in malondialdehyde levels by improving blood flow and removing this toxic metabolic by-product from cells, indicating an antioxidant effect similar to that of vitamin E. EECP's antioxidant effects are among the biochemical changes that help explain the long-term benefits of this treatment.[17]

Could EECP be the fountain of youth? I don't know if I would go *that* far, but there is no doubt that the blood flow it stimulates, combined with the myriad physiological responses to this blood flow, all work to maximize the body's health and well-being.

Oxygenating Muscles

In order to work harder during exercise, muscles demand extra oxygen. And of course, the only way to boost oxygen delivery is to boost blood flow. To meet this demand for more oxygen, muscles have a built-in mechanism to distribute more blood throughout their fibers during exercise. The mechanism is made up of two key components. First, exercise stimulates additional capillaries in the muscle to open, allowing for more blood flow. Second, as muscles contract, the shape of these capillaries changes in order to maximize their

surface area and the number of muscle fibers they are able to reach.

Muscles also demand extra oxygen *after* exercise. They need it to recover, to minimize postexercise fatigue and soreness, and to get ready for the next workout. Muscle fatigue comes from lactic acid buildup during exercise, a byproduct of muscle metabolism, while soreness comes from small tears in muscle cells or fibers (known as *delayed onset muscle soreness,* or DOMS). Delayed onset muscle soreness typically manifests several hours after exercise, and if left untreated, will likely resolve in three to seven days, as long as you avoid rigorous activities that increase pain. Both fatigue and soreness increase the risk of injury in athletes and in those who exercise regularly.

Athletes can lessen the effects of fatigue and soreness, reduce their risk of injury, and reduce their recovery time between workouts by increasing blood flow to tired muscles after exercise. The oxygen and nutrients delivered through blood aid the healing process and help wash out the irritating chemicals that were released when the muscle tears occurred. With a faster rebound time and less soreness and fatigue, the athlete can count on a stronger

performance the next time they hit the court, track, or field.

Many athletes looking for an edge incorporate a cooldown period into their training as a means of decreasing the lactic acid in their blood. This cooldown period often consists of easy, low-impact aerobic exercise because it increases blood flow to the affected muscles without creating more significant trauma. However, these athletes face a problem: although cooldown (active recovery) decreases lactic acid levels more quickly than rest (passive recovery), it further depletes the very energy stores that need to be replenished, since any active muscle movement requires energy. In other words, exercising to help muscles recover from the strain of previous exercise actually increases the risk of even more muscle fatigue, soreness, and injury.

This dilemma leads many professional athletes to receive massage therapy after a workout or competition. Massage's many benefits are well-documented. It stimulates blood flow without exertion and spurs the healing process. Specifically, massage increases circulation, improves range of motion and flexibility, stimulates the lymphatic system, strengthens the immune system, improves joint mobility, breaks up

scar tissue, relaxes muscles, and rids muscles of lactic acid and toxins, allowing an individual to rebound from exercise two to three times faster than they would without massage. Massage also reduces anxiety, injury risk, and pain.

I mentioned before that patients say EECP feels like a deep muscle massage. They are right on target. As the leg cuffs squeeze and release, they create all the benefits of traditional massage. But as passive exercise, EECP offers athletes an even better aid than massage. EECP stimulates significantly more blood flow than is possible from massage, to a degree similar to vigorous exercise but without expending energy and bringing the accompanying risk. Muscles respond to the treatment by triggering the first component of their blood distribution mechanism described earlier: waking up additional capillaries to accommodate the increased blood flow. By squeezing the legs and subtly changing the shape of muscles, EECP fuels the second component of the mechanism, causing capillaries to change shape to reach more areas of the muscle. In the process, EECP helps get rid of lactic acid and facilitates muscle repair without draining the body of energy stores needed

for the next workout. By doing so, EECP improves muscle function and performance and gets athletes back on the court, in the pool, or on the field faster and with less fatigue, pain, and risk of injury.

FLOW IS FUNDAMENTAL

EECP strengthens the most fundamental process in the human body: blood flow. As a result, it improves health and vitality in countless ways, from alleviating debilitating conditions to enhancing fitness in athletes. There is just one question that remains unanswered. In the next chapter, we will explore it.

6

HEART DISEASE IN MODERN MEDICINE

Why Haven't I Heard about This Before?

When I first meet people and begin to speak about EECP, their response is almost universal. Whether it is an individual who has been living with heart disease for decades and undergone multiple procedures over the years, a newly diagnosed patient, a family member of a heart disease sufferer, a personal friend, or a casual acquaintance, the reaction is the same: "Why haven't I heard about this before?" The question is nearly always asked with a combination of surprise, suspicion, excitement, and anger. Even physicians who have not had direct experience with EECP approach it with caution and hesitation.

"Why haven't I heard about this before?" It is the question that echoes in my mind,

day in and day out. EECP is virtually unknown, despite the fact that our new understanding of heart disease should inevitably lead us to seek a treatment that stimulates blood flow on a systemic level. It is virtually unknown, despite more than a hundred scientific studies that demonstrate EECP's incredible benefits. It is virtually unknown, despite its FDA and Medicare approval, its insurance coverage, and the fact that it is noninvasive, painless, effective, and entirely safe. Despite all of these compelling facts, EECP remains medicine's best-kept secret. Why? There is no easy, politically correct answer to this question. It is complex and symptomatic of a much greater issue in the American medical system. But in this chapter, I will offer my best explanation.

AMERICAN MEDICINE: THE HIGHER-TECH, THE BETTER

The United States has a long history of innovation, discovery, and technological advances. It is inextricable from the Wild West and frontier symbolism that characterized America's early days and, to a large degree, continues to define what we represent as a country. The American way is one of trailblazing and forging new ground, and the

American medical establishment follows the same tradition. It is why United States physicians and researchers are responsible for so many life-changing and lifesaving discoveries. Without this drive, we would not have the polio vaccine, cesarean section, kidney transplant, MRI, vitamin C, open-heart surgery, or countless other critical tools for keeping people alive and healthy.

These discoveries and many others are tremendous points of pride, and they stem from an approach to medicine that constantly strives to achieve the impossible. This approach teaches that the impossible is within our reach, that there is no limit to discovery. But in recent decades, with the astronomical growth in high-technology capabilities (computers, laser-guided equipment, and other precise mechanical devices), a pitfall of this philosophy has emerged alongside all the advances. The focus in American medicine today, it seems, is on high-tech innovation, while low-tech options are considered less worthy, viable, or exciting. The United States medical establishment has come to adopt the philosophy that the more complicated, risky, aggressive, and expensive the treatment, the better it must be. "In the U.S.," said William Boden, MD, pro-

fessor of medicine at the University of Connecticut School of Medicine, "there is the belief that 'more aggressive' is synonymous with 'better outcomes.' "[1] Such treatments typically fall into two categories: medications and invasive procedures or surgery. Treatments that fall outside these categories are not given much credence. They are not considered to be "real" medicine. In short, the American medical mind-set currently does not allow room for a noninvasive option.

This simplified, one-or-the-other approach to medicine serves as the foundation for many, if not most, United States medical school curricula. While some schools have begun to incorporate holistic or alternative medicine into their courses of study, most future physicians are taught that they have two choices: operate or medicate. They learn there is very little in between or otherwise, and it is this approach that they carry into their professional practice.

The practice of cardiology is perhaps one of the best examples of this mind-set in action. Even with numerous studies showing that invasive procedures do not adequately address heart disease and only prolong life in a very small percentage of

cases, their use remains widespread and even continues to grow. The attitude of many cardiologists is that the procedures are all they have, and they have to do something. This focus on invasive procedures does not allow for the consideration of EECP as a treatment option. In the context of the current Western medical tradition, EECP is too simple — too low-tech — to be credible. It is only offered to the sickest patients — those who cannot undergo additional surgery and have maximized their medications. Having exhausted the high-tech options, their cardiologist may then suggest EECP. And guess what? In the vast majority of cases, after EECP, they finally feel better! Then most ask, "Why didn't my doctor tell me about this sooner? Why did I have to go through all those procedures before I could try this?"

As I have stated previously, this discussion is certainly not meant to imply that surgery and pharmaceuticals have no place in modern medicine. They absolutely, unequivocally do. But I believe both are vastly overprescribed, to the exclusion of other noninvasive, accessible treatments that may work as well, if not better. Unfortunately, accepting a paradigm shift to first

treat heart disease patients with a non-invasive, inexpensive, outpatient procedure, and to save the more aggressive, risky, costly treatments as last resorts is a jarring thought for most Western physicians. In fact, it is one that most in the health-care industry cannot imagine. If the shift is to occur, it will do so at the demand of patients.

EECP WON'T PAY THE BILLS

In addition to being consistent with the prevailing mentality in Western medicine, the high-tech approach to managing heart disease — including all the bypasses, angioplasties, stents, hospitalizations, tests, and complex drug regimens — has one more thing going for it. It generates *hundreds of billions of dollars* every year for doctors, hospitals, pharmaceutical companies, and the health-care system at large. It is an incredibly lucrative business. The treatments provided to one heart disease patient could easily generate more than $1 million in health-care expenses over their lifetime. In 2003 (the last year for which data is available), a bypass operation cost an average of $83,919. In the same year, the average cost of an angioplasty was $39,255.[2] These figures include the signifi-

cant additional costs of the hospitalization, related tests, medications, and postoperative care. On the other hand, a standard course of EECP costs approximately $6,000, and it does not involve hospitalization, tests, drugs, or any other expenses. EECP patients are also less likely to be hospitalized in the future than heart disease sufferers who have undergone invasive procedures.[3] In short, EECP is not a particularly profitable treatment, and it makes patients less likely to need other, more profitable treatments down the road.

This is a controversial notion. Accepting — or even considering — that monetary concerns could influence the way doctors and hospitals care for patients is more than most people can bear. Rather than ask you to take my word for it, I will offer a few thoughts, observations, and experiences on the subject and leave you to draw your own conclusions.

There is tremendous competition in the health-care industry. Particularly in larger cities, hospitals must fight each other for every new and returning patient. When choosing a hospital, patients typically look for the newest, most technologically advanced facilities. It is one of the many factors in deciding where to go for care,

and it is consistent with our earlier discussion about the American tendency toward high technology. So in order to get and retain patients, hospitals invest in state-of-the-art equipment, renovate their campuses, and recruit prestigious physicians. Then they spend even more money advertising their top-of-the-line staff and facilities. How do they pay for all of this? One of their primary sources of income is from performing numerous expensive procedures. These operations keep hospitals in business. Additionally, state or federal regulations often require hospitals to perform a minimum number of procedures per year in order to keep certain facilities open. Catheterization labs and open-heart surgery programs, for example, are governed by such regulations in many states, including New York and New Jersey.[4] These requirements also extend to interventional cardiologists, who must often perform a minimum number of procedures to maintain their subspecialty certification.[5]

Somehow, the United States health-care system has found itself in a terrible ethical crisis. The industry and its practitioners — doctors, hospitals, pharmaceutical companies, and so on — make money when people are sick and require costly

treatments. Our health-care system's need and desire to generate revenue places it at fundamental odds with the patients it serves. The ancient Greek physician and philosopher Galen recognized this dilemma, asserting that the profit motive of medicine was incompatible with a serious devotion to the art of medicine. Finding ways to bridge this chasm — or failing to do so — continues to have a profound impact on the health of our citizens and our economy. While it is our responsibility as health-care providers to reconcile these conflicting inclinations, history suggests it may require the demands of our patients to bring about real change.

THE (UN)NATURAL ORDER OF THINGS

When a new medical treatment is introduced for any condition, it is first typically offered to those who have no other treatment options — the sickest, end-stage patients. Then, as the treatment becomes more familiar, as we gain experience with it and see its value for ourselves, and as more scientific studies are published to reinforce its effectiveness, it is moved up in the sequence of disease management to be used sooner rather than later.

The introduction of EECP as a treatment for heart disease has not followed this standard pattern. When it was first made available in the United States, it was reserved for the most advanced heart patients. But more than five years have passed since Medicare began paying for the treatment, and more than a hundred studies and papers have been published in every major cardiology journal that demonstrate its overwhelming effectiveness and unquestioned safety. Some studies even go as far as to conclude that EECP should be offered as a first-line treatment for heart disease, immediately upon diagnosis, long before surgery or other invasive procedures are used.[6] It is hard to imagine a more ringing endorsement.

Despite all of this, EECP is typically only offered to the hopeless, suffering heart patient who has tried every other treatment, sometimes repeatedly, and has no remaining options. Worse yet, EECP is not being offered widely even to this desperate population. There are 2.4 million patients in the United States with coronary artery disease who are unable to undergo bypass surgery or angioplasty because their physicians consider them inoperable. Aside from medications, EECP is their

only treatment option, their only hope for improved quality of life. But most are not informed that EECP exists.

Again, it appears that if a shift in this trend is to take place, it will do so at the demand of patients. We are already beginning to see many individuals, especially those who have recently been diagnosed with heart disease, who are doing their own research, discovering EECP, and choosing to forgo surgery or invasive procedures in favor of the noninvasive option.

HEART DISEASE: THE NOT-SO-STRAIGHT SCOOP

That EECP is unknown to so many heart disease sufferers is a serious matter, but it is indicative of an even larger problem. The fact is that the majority of heart disease patients and their families are misinformed about the true nature of the disease. I hear patients say, time and time again, that they believe blockages are the main problem in heart disease, and that "routine" procedures such as bypass surgery, angioplasty, or stent placement will clear or remove them and take care of their serious condition.

There are actually five layers to this misconception. First, of course, is that heart disease is a systemic illness. The main

problem is not that blockages exist, but that poorly functioning blood vessels cause poor blood flow throughout the body and particularly to the heart, creating an environment where blockages can develop. Therefore, the second layer is that procedures and operations that focus on blockages are only targeting a manifestation of the disease, not the disease itself. This distinction explains why bypass, angioplasty, and stents do not prolong life or prevent heart attacks. The third important point is that blockages cannot be removed. They are made of calcium and fats and, once present, become a permanent part of the blood vessel wall. Fourth, there is no such thing as a "routine" stent placement, angioplasty, or bypass operation. Each procedure brings the risk of infection, cognitive impairment, stroke, or even death. Complications may arise, and efforts to open or bypass blockages are not always successful. And lastly, it is not possible to "solve the problem." There is no cure for heart disease. Instead, the goal is to help patients *live* with it in the best possible way, minimizing symptoms, delaying its progression, and preventing events such as heart attacks. The primary way to achieve this goal is to strengthen

circulation and improve overall blood flow to the heart. Doing so not only reduces or eliminates symptoms such as chest pain, fatigue, shortness of breath, and a variety of others, it trains the heart and blood vessels to do their jobs more efficiently. In the process, blockages become irrelevant.

Because of the tremendous fear and anxiety a diagnosis of heart disease so often brings, many heart disease sufferers understandably want to believe there is a quick fix for their illness. This desire, supported by their misconceptions, often leads patients to undergo invasive procedures without exploring the alternatives. In fact, since the recommended procedures seem to appropriately treat the disease as they understand it, they rarely see a need to seek out other options. Unfortunately, these patients often have unreasonable expectations about what the procedures will accomplish and how simple they will be, and they are disappointed, confused, and angry when things do not go as they planned or their symptoms recur. I am frequently asked, "Why did I have to go through all of that, since I feel just as bad now as I did before?"

INFORMED CONSENT AND BIOETHICS

Why are so many heart disease sufferers misinformed about their disease? Whose responsibility is it to inform them? There are many possible answers to the first question, but only one to the last. It is a doctor's *obligation* to ensure that all of their patients fully understand their diagnosis, *all* of their treatment options, the risks and benefits of each, and what will happen if they choose to have no treatment at all.

Having an in-depth conversation like this with your doctor may be time-consuming. You may even think it sounds unlikely to happen, since your doctor's office may seem like a hectic place where one-on-one time is limited. But a physician's highest privilege and greatest responsibility is providing information to patients about their condition and treatment options and then guiding their decisions with the patient's best interests at heart. This allows the patient to give informed consent, to select a treatment based on all the relevant factors, and it is one of the central tenets of medical ethics. When we become physicians, we take the Hippocratic oath. A modern translation says, in part:

"I will apply, for the benefit of the sick, all measures which are required, avoiding those twin traps of overtreatment and therapeutic nihilism.

"I will remember that . . . warmth, sympathy, and understanding may outweigh the surgeon's knife or the chemist's drug."

In short, the physician plays a critical role as a middleman, filtering information to their patients. Patients, in turn, rely on their doctors for complete, accurate information about their choices and for treatment recommendations motivated only by what is in their best interest.

Despite this responsibility, many patients have told me that their physicians fostered a sense of urgency to undergo an invasive procedure for their heart disease. While some doctors implied that time was of the essence, others were more blatant. I have even heard of situations where patients were told, "I cannot guarantee you'll live through the weekend if you don't have a bypass immediately." But as we have seen, there are very few cases in which such procedures are true emergencies. Heart disease is a chronic, progressive condition, and it takes years for blockages to develop in arteries. In most cases, patients have time to get off the catheterization table,

take a deep breath, and carefully weigh their treatment options. A physician who implies that you must make a decision immediately when that is not truly the case has violated the tenet of informed consent and deprived you of the time and opportunity to explore alternatives.

Your physician must prevent or correct the five misconceptions about heart disease we listed in the previous section. In addition, they must fully discuss all of the treatments available to you — including EECP. If they fail to do either, you will not fully understand your illness, and you will not be able to make logical, informed treatment decisions or form realistic expectations. You have a fundamental right to demand these things and to find a doctor who will provide them to you.

Unfortunately, this scenario offers one of the strongest explanations for why EECP is still relatively unknown. If more patients understood the basic truths about heart disease — that it is a systemic illness; that blockages are not the problem and cannot be eliminated; that procedures targeting blockages are misguided and potentially risky; that there is rarely a need for emergency procedures; and that a proven, noninvasive treatment exists that offers a

logical, systemic solution — I would never again be asked, "Why haven't I heard about this before?" Patients would not subject themselves to invasive procedures aimed at bypassing, opening, or stenting blockages. They would demand EECP, and it would be universally recognized as the leading treatment for heart disease.

This need for information dissemination has led to a recent trend in medical practice called *information therapy.* It aims to support informed consent by providing specific, evidence-based medical information to a patient, caregiver, or consumer in writing to help that person make a particular health decision or behavior change.[7] The central premise is that information is as critical a component of one's health care as examinations, tests, and procedures. Health-care decisions should not depend upon a doctor choosing which facts to share or upon a patient accurately remembering what they were told. This approach is in keeping with the growing emphasis on patient self-management and shared decision making, and it is becoming increasingly popular, with some physicians actively pushing for its widespread use.

THE DOCTOR-PATIENT RELATIONSHIP

Patients only want to feel better, and they inherently believe their doctors have their best interests in mind when recommending treatments, procedures, and action plans. As a result, patients are often quick to follow their physicians' advice. On some level, many doctors are aware of this relationship, and they understand the high regard in which their patients hold them. Consciously or not, this power differential often plays an important role in the doctor-patient relationship: the doctor may prescribe a treatment without explaining why it is justified or discussing all of the alternatives, and the patient may follow these orders without asking questions or second-guessing them.

Ziauddin Sardar, a writer and philosopher at London's City University, offers this comment on the role of power in the doctor-patient relationship: "In non-Western traditions of medicine, the power of healing belongs to patients, not doctors. Doctors can offer remedies but they work with the power of the whole person, the patient. In the Western system, the power of the medical establishment, the consultants, and the doctors is absolute. No

wonder patients arriving in a hospital perceive themselves as helpless victims whose only function is to bring diseases for the doctors to fight and defeat."[8]

Despite this imbalance of power, your doctor has an undeniable responsibility to you that goes beyond ordering tests, performing procedures, and prescribing medication. As we saw earlier, your doctor is required to educate you fully about your diagnosis, all of your treatment options, related risks and benefits, and the consequences of doing nothing. But you have a responsibility as well. You must be proactive in your health. Ask questions. Do your own research. Be armed with all the information you can gather. Doing so is the only way you can be sure to get the care you need.

Above all else, don't be afraid to upset your doctor. Many people have told me that they fear their doctor would be offended to find out they came to me to learn about EECP. The last thing they want to do, they tell me, is to offend their doctor. I appreciate this sentiment. Many people have close, trusting relationships with their physicians. It may even be that their doctor saved their life at some point and they feel indebted to them. But your

doctor should not be offended or upset by your effort to learn about a treatment option. It is your right — actually, it is your *responsibility* — to educate yourself about your health. You must not be afraid of hurting your doctor's feelings in the process. You and your doctor should form a partnership for your care. It is your health that is of paramount importance, not your doctor's feelings. A physician who is truly on your side will welcome a two-way dialogue about *all* treatment options for your heart disease, including EECP. I believe most doctors fall into this category. Just try them!

INFORMATION IS POWER

In the fight against heart disease, information is your best weapon. Understanding all that you can about your systemic condition, being willing to ask questions, and forging collaborative relationships with your doctors will all but ensure that you will get the treatment you need. But your responsibility does not stop there. As we will see in the next chapter, there are many lifestyle choices you can, and must, make to maximize blood flow and stay on the path to good health.

7

STAYING ON THE PATH TO GOOD HEALTH

Taking Control after EECP

We now understand that blood flow is essential to health. We have also fully explored the exciting role EECP plays in treating heart disease and numerous other illnesses and conditions related to poor circulation. By dramatically improving blood flow, EECP puts patients on an upward spiral. But the good news does not and should not end with EECP; there are many behaviors we can adopt, modify, or eliminate to do our part to ensure that EECP's positive effects last as long as possible.

Whether you are living with heart disease or are concerned that you might be someday, the time to do all you can to reduce your risk factors is *now*. While some

factors are beyond your control, such as age and family history of heart disease, many others are not, and they offer important opportunities to slow the progression or even prevent the development of the disease. As you might have guessed, these risk factors have one thing in common: they all inhibit blood flow. If you have heart disease, keeping your blood flowing is the best way to fight its effects and enjoy the best possible quality of life. If you are healthy, keeping your blood flowing is the best way to stay that way. In this chapter, we will consider several critical steps you can take in your quest for strong blood flow and good health.

FIGHT THE TEMPTATION OF PHYSICAL INACTIVITY

For many Americans, life is becoming increasingly sedentary. Gone are the days when we would walk to the store, buy what we need for that day, and walk home. Instead, we drive virtually everywhere, sometimes without even getting out of the car when we arrive at our destination. (Even drugstores, banks, and dry cleaners have drive-through windows.) The Internet has brought the world to our living rooms, allowing us to shop, conduct research, and

socialize without ever leaving the sofa. Many of us have come to appreciate these conveniences, but they have paved the way for an epidemic that continues to grow, claiming countless lives every day. Physical activity is a casualty of modern convenience, with many dangerous ripple effects. According to the American Heart Association, 35.8 percent of men and 41.0 percent of women lead a sedentary life with no leisure-time physical activity.[1] The United States surgeon general reports that more than 60 percent of American adults are not regularly active, and 25 percent do not exercise at all. Inactive people have higher rates of heart disease, cancer, depression, and a host of other devastating ailments than people who engage in even mild physical activity.[2] Being sedentary not only increases your risk of developing coronary artery disease, it increases your risk of *dying* from the disease by 60 percent.[3]

Prevent or Reduce Obesity

The most noticeable result of physical inactivity may be weight gain, and eventually, obesity. Nearly one-third of American adults are obese, and another 35 percent are overweight. Approximately three hundred thousand United States adults die of

obesity-related causes each year.[4] Obesity inhibits blood vessel function and is recognized as a major risk factor for heart disease, stroke, insulin resistance and diabetes, high cholesterol, high blood pressure, and many other conditions. Unfortunately, Americans are showing no signs of getting this serious health risk under control. On the contrary, the percentage of obese Americans has increased by 75 percent since 1991.

The obesity epidemic is equally shocking among United States youth. Nearly 9.2 million children and adolescents aged six to nineteen — 16 percent of this population — are considered overweight or obese, and an additional 31 percent are at risk of falling into this category.[5] Communities across the country are releasing even more eye-opening statistics. In my own city of Philadelphia, a recent study revealed that 51 percent of children are overweight or obese.[6] As these overweight, sedentary kids grow up, they are at extremely high risk for all the complications of obesity. Obese children have been shown to have blood vessel dysfunction similar to that seen in adult heart disease sufferers. Even obese kids as young as five years old are more likely than children of

healthy weight to have high blood pressure and thickened heart muscles.[7] The thicker a person's heart muscle, the more likely they are to have reduced blood flow.

Are You at Risk?

Your body mass index (BMI), which is your weight in kilograms divided by your height in meters squared (kg/m^2), determines whether you are considered obese. People with a body mass index of twenty-five or more are classified as overweight, while those with a body mass index of thirty or higher are obese.

Several recent studies shed some light on the direct link between obesity and heart disease. They found that levels of leptin, a hormone secreted by fat cells, rise in tandem with levels of C-reactive protein, an inflammatory marker in the blood that is linked to heart disease risk.[8] Leptin poses a direct risk of heart attack similar to that of high blood pressure and low HDL ("good") cholesterol.[9] These findings again reinforce the relationship among heart disease, impaired blood flow, and inflammation.

GET MOVING!

"Exercise is good for you." This is a statement we have all heard, time and again, and most of us accept it as fact. But have you ever stopped to consider *why* exercise is good for you? You may say exercise makes you stronger and raises your metabolism, allowing you to lose weight or keep your weight under control. You may also note that exercise gives you more energy, keeps you feeling young, makes you fit, and improves your looks. The list of benefits goes on and on. But on the most basic level, *exercise gets your blood flowing*. When you exercise, your heart beats faster, causing your blood to pump more forcefully throughout your body — to every organ, tissue, and cell — and allowing all the processes that define a healthy body to occur. This increased blood flow is the fundamental reason why exercise is good for you; it is what gives rise to all of the other benefits you can think of.

The Science of Exercise

Scientists have discovered a direct cause-and-effect relationship between exercise (that is, blood flow) and health that offers a compelling, tangible incentive to be physi-

cally active. The landmark research that illustrated this connection was the Harvard Alumni Study. It followed seventeen thousand middle-aged Harvard graduates over a twenty-six-year period and monitored a number of variables, including exercise habits. The researchers concluded that those who exercised vigorously (jogging, swimming, cycling, tennis, and so on) had a 25 percent lower death rate than those who were more sedentary or engaged in non-vigorous activities (such as bowling, golf, or strolling).[10] Dr. Ralph Paffenbarger, one of the principal authors of the Harvard study and one of the world's leading authorities on exercise and longevity, has offered us a simple summation: for every hour you exercise, you get back that hour plus an extra hour of life.

But why is there such a direct relationship between exercise and good health? We understand that good blood flow is crucial to good health and that exercise gets your blood pumping. But what does the blood flow do to your bodily function that is so critical? The answer is simple: by increasing your blood flow, you are increasing oxygen delivery throughout your body and particularly to your heart. In the process, you are protecting and en-

hancing the health of your heart by conditioning it to work more efficiently. Conversely, when you are sedentary, you are putting your heart — and therefore your life — at risk.

Exercise Prevents and Reduces the Effects of Heart Disease

An overwhelming volume of scientific evidence demonstrates that regular exercise is cardioprotective and it helps slow the progression and reduce the severity of coronary artery disease.[11] Many studies have shown that physical activity reduces several cardiovascular risk factors such as diabetes, obesity, risk of thrombosis (blood clotting), and endothelial cell (blood vessel) dysfunction.[12] Exercise also improves levels of HDL ("good") cholesterol and lowers blood pressure, both factors known to protect against heart disease.[13] By reducing cardiovascular risk factors, exercise reduces the occurrence of heart disease–related death. For example, research shows that physically active people are less likely to have a heart attack, are better able to rebound from and survive a heart attack if one should occur, and have a lower risk of death due to heart disease.[14]

But we can go one level deeper in understanding why exercise is cardioprotective. We can determine what exercise does on a biological level to help prevent and slow the development of heart disease. Recall that inflammation damages blood vessels and is a key underlying cause of countless diseases and conditions, including heart disease. Also, recall our discussion in chapter 2 regarding the mechanics of blood flow. The friction of blood flow has direct anti-inflammatory effects on blood vessels.[15] Therefore, by increasing blood flow, exercise offers a natural way to counteract inflammation and protect blood vessels. This is not just a theory based on logic; researchers have quantified the anti-inflammatory effect of exercise by measuring the drop in C-reactive protein in the blood over time.[16]

If you have heart disease, one study has shown that you would be better served by exercising regularly than by undergoing an invasive procedure. Researchers at the University of Leipzig (Germany) concluded that heart patients who do not have an invasive procedure but do exercise daily (twenty minutes on a stationary bike) were 18 percent less likely to have a heart attack or other cardiac complication

over the next four years than heart patients who did not exercise regularly but did have a stent placed.[17] These results further underscore this fundamental message: improving blood flow *systemically*, throughout the body and therefore to the heart, does far more to improve health and protect the heart than focusing in on a specific blockage. Remember, heart disease is not about isolated blockages, so a localized treatment like a stent is merely a Band-Aid. It fails to address the underlying problem: lack of blood flow throughout the heart muscle. Exercise boosts health in all of the blood vessels and in the heart by stimulating blood flow everywhere.

In the case of exercise, there cannot be too much of a good thing. We have come to understand that there is a dose-response relationship between exercise and protection against cardiovascular disease, meaning the more you exercise, the healthier your heart is.[18] This is incredibly empowering news for people who are anxious to do all they can to prevent or slow the development of heart disease. It teaches us that there is something we can do every day, something that is free and does not require any special equipment or expertise.

to decrease our risk of falling victim to the number-one killer in our society.

Exercise Leads to Weight Loss and Better Health

It is well understood that exercise helps you lose weight and maintain a healthy weight by increasing your energy expenditure and metabolic rate.[19] What is even more exciting, though, is the fact that as you lose weight, you open the door to the variety of other health benefits that naturally follow.

There is no better time than during childhood to reduce the damaging effects of physical inactivity and obesity. Simple lifestyle changes such as exercising regularly and adopting a low-fat diet lead to a marked improvement in blood vessel function in obese children, not only signaling a young body's ability to heal, but also again highlighting the fact that blood flow is the key underlying determinant of heart health.[20]

But while it is best to chart a healthy course when you are young and stop bad habits before they start, overweight and obese adults must never think they are too old to improve their health. Obese adults gain significant benefits from exercise,

even without dieting or reducing caloric intake. One study, conducted by Duke University's Center for Health Policy and Research, followed three groups of patients aged forty to sixty-five during an eight-month period of exercise. One group jogged twenty miles per week, one jogged twelve miles per week, and one walked twelve miles per week. All three groups lost significant weight and body fat. The group that jogged twenty miles per week lost the most, and the groups that walked or jogged twelve miles per week lost about the same as each other. The researchers concluded that most obese individuals can lose substantial weight and fat mass by walking thirty minutes every day.[21]

The weight loss that results from exercise has tangible benefits in the fight against heart disease. A study from CCS Haryana Agricultural University of India recently documented that obese postmenopausal women who exercised one hour per day for three months lost weight, lowered their blood pressure and cholesterol, and enjoyed increased energy and activity levels.[22] In another study, researchers at Queen's University in Ontario, Canada, found that obese premenopausal women who exercised daily for fourteen

weeks experienced substantial reductions in total fat, abdominal fat, visceral fat (which surrounds internal organs and is particularly dangerous), and insulin resistance. They obtained these benefits even without dieting or cutting back on calories.[23]

A University of Liverpool (England) study of obese individuals aged thirty-seven to forty-seven who participated in moderate aerobic exercise (walking on a treadmill or riding a stationary bicycle) for eight weeks found that the subjects reduced their body weight, body fat, and waist size. Interestingly, this study divided participants into two groups. Each group burned the same total number of calories per week (two thousand), but one group exercised five times per week and burned four hundred calories during each session, and the other exercised only twice per week, burning one thousand calories per session. Both groups achieved the same significant benefits, suggesting that total weekly energy expenditure is what is most important in using exercise as a weight-loss tool.[24]

Exercise Offers You Options

The Centers for Disease Control and Prevention, together with the American College of Sports Medicine, recommends you exercise aerobically (walking, swimming, jogging, dancing, and so on) for at least thirty minutes per day, five days per week, at your target heart rate in order to achieve cardiovascular benefit. If you cannot precisely calculate your heart rate while you exercise, here is a tip: try to achieve an intensity level that you would consider moderate to moderately hard. It should cause you to perspire a bit and to breathe more rapidly than while you are at rest. But you should not be working so intensely that you are unable to speak in full sentences.

As you know, there are countless gurus, trainers, books, videotapes, magazines, and websites that tout "the best" or "most complete" or "fastest" or "easiest" exercise regimen. But there is no one best program or technique. The point is to get moving. Certain programs and approaches may feel better to you, may be more enjoyable or convenient, or may address your particular needs more than others. But any activity that improves your blood flow will give you the desired benefits: decreasing your risk of disease; enhancing your fit-

ness, strength, flexibility, and body composition; and greatly improving your quality of life. On pages 265–267 is a sampling of types of physical activity and the documented benefits each has on cardiovascular health.

The List of Exercise's Benefits Just Keeps Growing

As if all these facts weren't reason enough to put down this book and get moving, the list of exercise's benefits just keeps growing. Research has shown that physical activity:

- Decreases depression and anxiety and improves mood [25]
- Plays a substantial role in developing bone mass during childhood and adolescence, and in improving and maintaining skeletal mass into adulthood, decreasing the risk of hip fractures later in life [26]
- Decreases the risk of colon cancer, breast cancer, and prostate cancer [27]
- Lowers the risk of diabetes [28] and helps prevent the progression of

the disease in those who have diabetes [29]

- Strengthens the body's antioxidant mechanisms, helping to slow the aging process, fight disease progression, and create a younger, healthier, and more fit appearance and attitude
- Enhances blood flow in limb muscles, thereby improving overall muscle function and performance
- Improves balance and joint flexibility
- Boosts self-image and self-esteem
- Improves sleep patterns, thereby helping individuals look and feel more relaxed and rested

Calculating Your Target Heart Rate

1. Determine your maximum heart rate: 220 minus your age in years. (For example, if you are 50, your maximum heart rate is 220 – 50 = 170 beats per minute.)

2. Your target heart rate is 50 to 80

percent of your maximum heart rate. (For example, 50 percent of 170 = 85; 80 percent of 170 = 136. Your target heart rate = 85 to 136 beats per minute.)

It is easy to find excuses not to exercise. You are too busy, the weather is not cooperating, you do not have access to an exercise facility or the proper equipment, and so on. But exercise can take many forms. It does not have to be a grand production in order to provide cardiovascular benefit and improve your health. You do not even need an uninterrupted block of time in which to do it. The National Heart, Lung, and Blood Institute at the National Institutes of Health says exercise will still be effective if it is divided into multiple ten- to twenty-minute sessions per day. It is your total amount of activity each day that counts.

The importance of being active cannot be overstated, and there are more opportunities to add physical activity to your daily life than you might realize. Take the longer route to your next meeting. Park at the far end of the parking lot. Walk around

the airport while you wait for your flight. Use the steps instead of the elevator or escalator. Set aside some more time to work in the garden. Even these seemingly small lifestyle changes will increase your physical activity and be as effective as a formal exercise routine in improving your fitness level, lowering your blood pressure, and reducing your risk of heart disease.[30] So let's get moving!

MANAGE STRESS AND ANXIETY

Scientists have identified clear connections between emotional stress, persistent levels of stress hormones in your body such as adrenaline, cortisol, and norepinephrine, and various illnesses and diseases. Recently, evidence has emerged that anger, hostility, and depression raise blood levels of C-reactive protein, the inflammatory marker linked to heart disease.[31] In short, when you are emotionally upset, your body releases hormones that cause your blood vessels to constrict, thereby impairing blood flow. Learning to cope with stress and manage it effectively when it arises, therefore, is essential not only to your emotional and psychological health, but to your physical health as well.

Cardiovascular Benefits of Exercise

Exercise Type Aerobic exercise (cycling, running, etc.)

Duration/ Frequency/Time 4 months • 3x/week • 60 minutes

Benefits • Improves cardiovascular fitness, allowing greater blood flow throughout the body with less effort • Increases HDL ("good") cholesterol, protecting blood vessels from further blockage [32]

Exercise Type Low-impact aerobics

Duration/ Frequency/Time 3 months • 3x/week • 60 minutes

Benefits • Improves cardiovascular fitness, allowing greater blood flow throughout the body with less effort [33]

Exercise Type Tai chi

Duration/ Frequency/Time 3 months • 2x/week • 60 minutes

Benefits • Improves cardiovascular fitness, allowing greater blood flow throughout the body with less effort • Improves fluid balance and heart muscle performance [34]

Exercise Type Strength training

Duration/ Frequency/Time 4 months • 3x/week • 60 minutes

Benefits • Decreases heart rate and blood pressure, thus relaxing the cardiovascular system and allowing for increased blood flow throughout the body with less effort [35]

Exercise Type Walking

Duration/ Frequency/Time 6 weeks • 5x/week • 30 minutes

Benefits • Improves cardiovascular fitness, allowing greater blood flow throughout the body with less effort • Increases HDL and lowers total cholesterol and triglycerides, protecting blood vessels from further blockage [36]

Exercise Type Swimming

Duration/ Frequency/Time 10 weeks • 3x/week • 30 minutes

Benefits • Decreases blood pressure [37]

Exercise Type Yoga

Duration/ Frequency/Time 3 months • 7x/week • 60 minutes

Benefits • Lowers heart rate and blood pressure, relaxes the cardiovascular system allowing for increased blood flow throughout body with less effort • Decreases total cholesterol, protecting blood vessels from further blockage • Decreases the likelihood of blood clots, allowing blood to flow more freely [38]

Our bodies offer many signals that stress is building. You may get a headache, experience indigestion, feel muscle tension, have difficulty sleeping, or grind your teeth. You could experience a racing heart, sweaty palms, fatigue, general aches and

pains, or an upset stomach. Or you may feel angry, anxious, depressed, irritable, lonely, or nervous. Any of these symptoms, alone or in combination, are signals of stress. They manifest differently in everyone, but they must not be ignored.

Once you identify the signs, you can learn to manage stress using proven techniques. By improving your coping strategies and learning to relax, your blood vessels will dilate and your blood flow will improve. Common effective stress management methods include:

- Eating and drinking sensibly
- Quitting smoking
- Improving communications with your family, friends, and coworkers
- Getting enough rest
- Exercising regularly
- Managing your time effectively
- Asking for help when you think you need it
- Learning to relax (finding the technique or techniques that work best for you, such as breathing exercises, progressive muscle relaxation, mental imagery relaxation, or biofeedback)

QUIT SMOKING

While there have been many attempts over the past several decades to raise public awareness of the dangers of cigarette smoking, it continues to be the nation's leading preventable cause of death and disease. Smoking is responsible for more than 442,000 premature deaths in the United States each year. Worldwide, there will soon be six million deaths per year due to tobacco use, putting smoking on the same level as the HIV/AIDS epidemic. Most Americans are aware that it causes emphysema, lung cancer, and other serious breathing problems, but many do not recognize that cigarette smoking has devastating effects on the cardiovascular system. In fact, tobacco use causes more deaths from heart disease and stroke than from lung cancer. Smoking is responsible for about 30 percent of all deaths from heart disease in the United States.

The World Health Organization's Multinational Monitoring of Trends and Determinants in Cardiovascular Disease (MONICA) project conducted a study of more than 131,000 men and women from twenty-one countries and found that smoking substantially raises the risk of

heart attacks in adults aged thirty-five to thirty-nine. Smokers in this age group are five times more likely than their non-smoking counterparts to have a heart attack. The MONICA project researchers concluded that half of all heart attacks in people under fifty could be prevented with smoking cessation.[39]

A British study on smoking and mortality among male doctors continues to yield new information more than fifty years after it began.[40] In 1951, the British Doctors Study, as it is known, began monitoring nearly thirty-five thousand male doctors born prior to 1930. The first data to arise from this study was published in 1954.[41] The publication was a landmark event, as it was one of the first to establish a link between smoking and lung cancer, and between smoking and heart attacks. Based on what they learned, the investigators gradually compiled a list of twenty-four diseases and conditions that are clearly caused by smoking, including high blood pressure, coronary artery disease, heart attack, heart failure, and stroke.

How Does Smoking Increase Heart Disease Risk?

It only takes three seconds for your body to begin feeling the harmful effects of smoking. Your heart beats faster, your blood pressure rises, and the carbon monoxide in smoke removes oxygen from your blood.[42] As we have discussed, blood flow is critical because it delivers the nutrients and oxygen that all the cells in your body need in order to function properly. However, it really does not matter how much blood is flowing if it has been stripped of its oxygen. Without oxygen, cells die. And when your heart senses it is not getting the oxygen it needs, it pumps faster and works harder to try to boost blood flow in hopes of boosting oxygen delivery. So when smoke removes oxygen from your blood, it is effectively killing your cells and straining your heart. Conversely, when you stop smoking, more blood and oxygen is immediately delivered throughout your body.

The chemical culprit in cigarettes, and in tobacco of any form, is nicotine. Nicotine has numerous deadly effects on the body. Primarily, it constricts your blood vessels and causes them to spasm. When blood vessels constrict, blood flow is reduced, blood pressure rises, and the heart

again must strain to get its job done. (This is why smokers tend to have cold feet and hands, and they often appear pale.) In addition, it appears that smoking both accelerates the buildup of plaque in arteries and causes these plaques to rupture. At the same time, nicotine promotes blood clotting. This deadly combination can lead to the abrupt, complete blockage of an artery feeding the heart, thereby triggering a serious heart attack.[43]

There is seemingly no end to the bad news about nicotine. Endothelial cells are the critically important cells that line blood vessels and are responsible for promoting healthy blood flow throughout the body. Endothelial cells can develop from stem cells (endothelial progenitor cells), which are present in the circulation. These progenitor cells help to repair the lining of blood vessels by settling on the blood vessel wall in a place where new, healthy endothelial cells are needed. A low progenitor cell count is a strong predictor for heart disease. Nicotine is poisonous to progenitor cells, as evidenced by the fact that smokers have lower levels of progenitor cells than nonsmokers. The more people smoke, the fewer progenitor cells they have. Tellingly, when smokers quit

smoking, their levels of progenitor cells tend to rise rapidly, and when they resume smoking, their levels drop again, almost to the original low numbers.[44]

Smokers have significantly higher levels of three inflammatory and blood-clotting factors in their blood than nonsmokers. Each of the substances — C-reactive protein, homocysteine, and fibrinogen — has been linked to an increased risk of heart disease. Former smokers have only slightly elevated levels of these markers compared to nonsmokers, demonstrating again that it is never too late to quit smoking and take a positive step toward reducing your risk of heart disease.[45]

In addition to its harmful effects on blood vessel function, heart function, and blood flow, smoking aggravates a variety of other known risks for heart disease. It increases LDL ("bad") cholesterol, decreases HDL ("good") cholesterol, and increases the risk of diabetes by making the body more resistant to insulin.

Passive Smoking Kills Too

If you choose to smoke, you are not only robbing your body of oxygen, impairing your circulation and blood flow, and seriously damaging your health, you are simi-

larly affecting those around you. Passive smoking — secondhand smoke inhaled by nonsmokers living or socializing with smokers — is thought to increase the risk of heart disease by as much as 50 percent and contributes to thirty-five thousand U.S. deaths annually.[46]

Several U.S. states — including Delaware, California, and New York — and more than 1,700 American cities and towns have instituted smoking bans in all public indoor spaces in an effort to protect nonsmokers from this health risk. Australia, Ireland, Italy, Canada, Iran, the Netherlands, and Norway have introduced such bans nationwide. Studies suggest the positive effects of these laws on public health in the coming years will be staggering. For example, the city of Helena, Montana, passed a smoking ban in workplaces more than two years ago, and although it was overturned six months later, the number of heart attacks in that city dropped by 40 percent during the time the law was in effect.[47] Another study concluded that while only 69 percent of American indoor workers are currently protected by a smoke-free workplace policy, a nationwide ban could prevent thousands of heart attacks, strokes, and

deaths each year, and it would encourage approximately 1.3 million people to quit smoking within just the first five years of the ban.[48]

The British Doctors Study arrived at an important conclusion that offers hope and incentive to current smokers: it is never too late to quit. The study found that the risks associated with smoking quickly diminish after you stop. A thirty-year-old, for example, who quits smoking will avoid almost all of the excess mortality risk associated with tobacco use. People who quit smoking by age forty will regain an extra nine years of life. Those who stop at age fifty will regain six years, and people who quit by the time they are sixty will regain three years. Whatever your age, quitting smoking — or minimizing your passive exposure to smoke — is one of the most important steps you can take toward enhancing your blood flow, lowering your heart disease risk, and improving your overall health.

DRINK ALCOHOL ONLY IN MODERATION

Much attention has been paid in recent years to the relationship between alcohol and heart disease. Many reports indicate

that moderate drinking raises HDL ("good") cholesterol, lowers blood pressure, inhibits the formation of blood clots (which can be both good and bad, as it may increase the risk of bleeding but may decrease the risk of a heart attack), and helps prevent artery damage caused by elevated LDL ("bad") cholesterol. Indeed, moderate drinking does appear to offer some protection against heart disease for certain people. Moderate drinking is defined as no more than one drink for women and no more than two drinks for men per day. A drink is defined as 1.5 ounces of 80-proof or 1 ounce of 100-proof liquor, 5 ounces of wine, or 12 ounces of regular or light beer.

Of course, many of the benefits from moderate alcohol consumption listed above can be achieved through proper diet and exercise, and there is an important flipside to the encouraging reports on moderate drinking. Consuming too much alcohol can lead to many serious health problems, including high blood pressure (which inhibits blood flow), diseases of the liver and pancreas, and damage to your heart and brain. The American Heart Association cautions people *not* to start drinking if they do not currently drink alcohol. If you do drink, curtailing the

amount of alcohol you consume will enable you to reduce your blood pressure and allow your blood to flow more freely.

MANAGE HIGH BLOOD PRESSURE, DIABETES, AND CHOLESTEROL

Several medical conditions, if not controlled, can increase cardiovascular risk. Chief among these are high blood pressure, diabetes, and cholesterol.

Control High Blood Pressure (Hypertension)

When you have high blood pressure, or hypertension, your blood vessels become stiff and the force of blood against your artery walls is too strong. This pressure causes damage to your blood vessels and vital organs. Hypertension is commonly called the "silent killer" because its symptoms — headache, visual disturbances, nausea, and vomiting — often do not emerge until the situation is severe and the damage has been done. An estimated sixty-five million Americans — nearly one-third of United States adults — have hypertension, defined as levels of 140/90 mmHg or higher, and an additional 30 percent of the population is considered "prehypertensive."[49]

Understanding blood pressure. A blood pressure measurement consists of two numbers. The top number is called the *systolic blood pressure;* it represents the pressure against your artery walls just after your heart has pumped to send blood out to the body. The bottom number is called the *diastolic blood pressure;* it represents the pressure against your artery walls between heartbeats, when your heart is relaxed. The numbers are measured in millimeters of mercury (mmHg) and are classified as follows, based on guidelines from the National Institutes of Health:[50]

Understand Your Blood Pressure

Classification: Systolic Blood Pressure

High blood pressure	140 or above
Prehypertension	120-139
Normal adult blood pressure	119 or below

Classification: Diastolic Blood Pressure

High blood pressure	90 or above
Prehypertension	80-89
Normal adult blood pressure	79 or below

Factors causing hypertension. We cannot usually pinpoint why high blood pressure exists in a particular person, but many factors are known to significantly contribute to the development of hypertension. These include family history of hypertension; obesity; consuming three or more alcoholic drinks per day; high salt intake; low calcium, magnesium, or potassium intake; insulin resistance; and aging. Hormones released during periods of emotional or physical stress may also raise blood pressure by causing blood vessels to narrow, thereby impairing blood flow.

Treating hypertension. Lifestyle modifications are essential to managing high blood pressure. The obvious steps include increasing your level of physical activity, losing excess weight, quitting smoking, limiting alcohol use, learning to effectively cope with stress, and cutting back on salt intake. A low-fat diet called Dietary Approaches to Stop Hypertension (DASH) is often recommended and emphasizes whole grains, vegetables, and fruit. In addition, you have to be sure your intake of calcium, magnesium, and potassium is sufficient. If you are not able to control your blood pressure by making these lifestyle changes, your doctor may prescribe medication. It

is not uncommon for a patient to require more than one medication to maintain their blood pressure in the desired range.

Regardless of whether you can control your hypertension by changing your habits or you must take medication, effectively managing this condition is crucial to your overall health. It offers yet another means for promoting blood flow and reducing your risk of heart disease.

Keep Diabetes in Check

Diabetes mellitus results from problems with insulin in the body. Insulin is a hormone produced by the pancreas that transports glucose (sugar), a major form of nutrition necessary for cells to function properly, from the blood into all of the body's cells. Most individuals with diabetes do not produce enough insulin. Without adequate insulin, glucose builds up in the blood and is unavailable for use by cells. Blood sugar level, the amount of glucose in the blood, indicates whether there is enough insulin, and is therefore the gauge individuals with diabetes use to control their condition.

An important precursor to diabetes — and a syndrome that increases heart disease risk — is a phenomenon called *insulin*

resistance, when the body does not efficiently use the insulin it produces. In this situation, the pancreas attempts to regulate blood sugar levels by releasing more and more insulin. Gradually, though, the pancreas's insulin-producing cells burn out and become inactive. As a result, blood sugar slowly rises and full-blown diabetes develops. Insulin resistance is part of a metabolic syndrome that includes increased LDL ("bad") cholesterol levels and triglycerides and decreased HDL ("good") cholesterol levels. More than sixty million Americans are insulin resistant, and 25 percent of them will go on to develop diabetes.

Most individuals with diabetes control their disease through proper diet, weight management, oral medications, and in some cases, insulin injections. Finding the right balance is of the utmost importance, as diabetes contributes to more than 218,000 deaths each year and leads to a host of medical complications, most of them circulatory in nature, including heart disease, stroke, peripheral vascular disease, visual impairment, neuropathy, and kidney disease. People with diabetes are two to four times more likely than those without the disorder to die from

cardiovascular disease; heart disease is the leading cause of diabetes-related deaths.

Keep an Eye on Cholesterol

Contrary to popular belief, not all cholesterol is bad. In fact, it can be a very useful substance. Cholesterol helps your body build new cells, produce needed hormones, and insulate nerves. Your liver manufactures all the cholesterol your body needs, but cholesterol also enters the body through the foods you eat, primarily through animal-based foods such as meat, eggs, and milk. It is this dietary cholesterol that often poses a risk of heart disease.

Most people are aware that high cholesterol is to be avoided and that your risk of heart disease increases as your cholesterol level increases. The danger arises when excess cholesterol builds up in the walls of your arteries, causing what is commonly referred to as "hardening of the arteries." This buildup leads to atherosclerosis and compromised blood flow. But we have come to recognize that dietary cholesterol can either benefit or harm you, depending on the type. HDL (high-density lipoprotein or "good") cholesterol actually works to clear cholesterol from your blood and has some protective effects against heart

disease. LDL (low-density lipoprotein or "bad") cholesterol is the main source of artery-clogging plaque that impairs circulation. High levels of triglycerides, another fat in your bloodstream, have also been linked to heart disease.

There are no outward symptoms of high cholesterol or high triglycerides. A blood test is the only way to measure your levels. It is recommended that everyone over the age of twenty have their lipid levels (that is, total cholesterol level, LDL, HDL, and triglycerides) checked every five years. Here is how to interpret your numbers:[51]

Understand Your Total Cholesterol

Total Cholesterol (in mg/dL)	Category
< 200	Desirable
200-239	Borderline
> 240	High

Understand Your LDL Cholesterol

LDL Cholesterol (in mg/dL)	Category
< 100	Optimal — particularly if at very high risk of heart disease

LDL Cholesterol (in mg/dL)	Category
100-129	Near optimal — particularly if at moderate risk of heart disease
130-159	Borderline — particularly if at moderate to high risk of heart disease
160-189	High — particularly with one other risk factor for heart Disease
> 190	Very high

Understand Your HDL Cholesterol

HDL Cholesterol (in mg/dL)	Category
> 60	Desirable
40-59	Borderline
< 40	Too Low

Understand Your Triglycerides

Triglycerides (in mg/dL)	Category
< 150	Desirable
150-199	Borderline
> 200	High

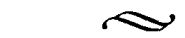
A variety of factors can affect your lipid levels. Eating a diet low in cholesterol and saturated fat, maintaining a healthy weight, and exercising regularly will lower cholesterol and triglyceride levels and reduce your risk for heart disease. If these lifestyle modifications do not achieve the desired results, or if you have a strong hereditary component to your high lipid level, medication might be in order.

LIVE LONG AND WELL

While some of the statistics in this chapter paint a frightening picture, we have the power to dramatically improve *all* of them. In our quest for good health, it is exciting to consider how many opportunities exist to enhance blood flow and stack the odds in our favor. It may be enormously challenging to make some of the lifestyle changes we discussed here, but consider the benefits! Eliminating these serious risk factors or bringing them under control can help you win the fight against heart disease and so many other conditions and live a longer, healthier, fuller life.

In the next chapter, we will see that the future of medicine is here now. EECP has placed us on the brink of conquering heart disease and countless other conditions — and transforming an entire industry in the process.

8



THE EVOLUTION OF A REVOLUTION

EECP and the Future of Medicine

One of a physician's greatest challenges is to accept the fact that the truth changes. What is medical fact today may easily be disproved tomorrow. We study and train for years, only to discover that a cornerstone of thought and practice has become a thing of the past. Embracing this reality is often a humbling experience.

It is equally challenging — and equally important — to allow the changing truth to bring progress to our routine. We must ensure that our practice of medicine keeps pace with science. I strive to expand my knowledge every day so that I may offer my patients the most up-to-the-minute medical guidance possible. But as we discovered earlier, history suggests we have

not always met this challenge, and it can take many, many years for new ideas to be accepted and integrated into practice. Bloodletting, for example, was used for hundreds of years after it was shown to be baseless because physicans had no other treatments to offer but felt compelled to treat anyway. It is thought to be responsible for countless illnesses and deaths as a result. And in 1847, a physician in Vienna concluded that doctors who performed autopsies and then immediately delivered babies without washing their hands were communicating deadly infections to women and children. He ordered his staff to wash and sterilize their hands before treating each patient, and he was gratified to see the death rate quickly drop. But doctors were offended by the notion that they were responsible for their patients' demise. The physician who advocated hand washing was ridiculed, and the practice was abandoned. It took nearly twenty years for doctors to revisit sterilization and make it part of their routine. It is truly horrifying to consider how many patients were lost before this knowledge turned into habit.

The story of EECP's evolution in the United States provides an excellent illus-

tration of what can happen when medical progress lags behind scientific truth. EECP was first introduced in studies on humans in the early 1970s, and it was shown to offer tremendous clinical benefits. Several years ago, I spoke to a technician who worked in one of the labs where EECP was first studied. "We just could not believe what we were seeing," he recalled. "The amount of blood flow in the coronary arteries was astounding. We knew we were on to something big." That was thirty years ago. As we have seen, the treatment has been largely ignored, primarily because the EECP machine itself was cumbersome and not as exciting to physicians as the technologically advanced surgical and invasive techniques that were emerging at the same time.

Despite the excitement it generated among researchers in the United States, EECP was all but forgotten during the next twenty years. However, China saw EECP's remarkable value, further developed it into the user-friendly, comfortable device we use today, and quickly elevated it to the heart disease treatment of choice. It was not until the early 1990s — when U.S. doctors were faced with a grow-

ing, aging population of postsurgical cardiac survivors who were more medically complex than younger patients and were suffering from reemerging heart disease symptoms — that U.S. interest in EECP was renewed. Doctors recognized that the high-risk, end-stage heart disease patient needed another treatment option. The clinical results this group enjoyed from EECP were extraordinary, just as they were two decades earlier. Again, researchers knew they were on to something big.

Only the sickest patients were included in studies on EECP's effects, making the significant, positive outcomes that much more exciting. Proponents of the treatment began to marvel that the results would be even more extraordinary if patients were offered EECP before their disease became so advanced. Still, physicians insisted on reserving EECP as a last resort, and they offered it only to end-stage patients who could not undergo surgery or invasive procedures.

There was no scientific basis for this approach. In fact, it was just the opposite. As EECP was slowly being introduced into medical practice for selected patients, researchers were making a stag-

gering discovery. Study after study was casting doubt on what was thought to be a central truth of heart disease. We were learning that the disease is not, as we had thought for so long, defined by specific blockages. It is a systemic illness that affects the entire circulatory system. All of a sudden, fact had become fallacy, and the basis for modern heart disease management — attacking blockages by bypassing them, pushing them out of the way, scraping them, or irradiating them — was slipping away. Inflammation was now recognized as a key underlying factor in heart disease, but the invasive operations and procedures physicians used to battle the condition actually created more inflammation. They were aggravating the problem, contributing to an environment where heart disease may continue to flourish, rather than improving the situation.

To the medical community, it was a jarring and unwelcome realization. The high-tech and costly invasive approaches had become a multibillion-dollar industry, and they had prompted an exponential rise in the number of heart surgery programs, catheterization laboratories, cardiothoracic surgeons, and invasive cardiologists. In fact, the new, accepted truths

about heart disease not only failed to bring about a change in the way the condition was treated, but the news did not even reach the general public for many years. On the contrary, the number of procedures aimed at opening or bypassing blockages has continued to climb steadily for the past fifteen years, with no end in sight. Only a few renegade physicians dared to speak publicly about the systemic nature of heart disease, and they were often dismissed.

Slowly, over the years, increasing numbers of well-known and well-respected cardiologists have spoken and written openly about the shift in our understanding of heart disease, calling for a systemic treatment as the first-line approach and urging that surgery and invasive procedures should be reserved only for the most critical patients who have failed all other measures. The opinion that treating the cause of the disease makes more clinical sense than simply treating the symptoms is gaining ground. In a recent continuing education course for physicians, Steven E. Nissen, MD, vice-chairman of cardiology at the Cleveland Clinic Foundation, explained, "Unless you treat [coronary artery disease] as a sys-

temic disease, unless you change the metabolic milieu that caused this disease to develop, you will not change the outcome."[1]

In the growing number of books and articles about our new definition of heart disease and the need for a new approach, medications and lifestyle changes such as regular exercise, proper diet, and smoking cessation are the "solutions" consistently recommended. But each and every writer on this topic has stopped short of recommending a medical treatment, which has left patients asking, "If the invasive procedures don't treat heart disease, what does?"

THE SYSTEMIC SOLUTION TO A SYSTEMIC PROBLEM

What is curiously absent in these calls to action is the exciting news that a treatment exists that unequivocally provides an appropriate, systemic remedy for what we now know is a systemic disease. It is noninvasive, already clinically proven, and covered by insurance. It improves blood flow to the heart and throughout the body, improves the health of all blood vessels, and therefore is the only treatment that logically fights heart disease at its root. It is suitable for

nearly every person living with the condition, from an individual who just got word of an abnormality on their stress test to a gravely ill, end-stage patient who has tried everything. It puts their bodies in a better place to live with heart disease and to fight it. It is EECP.

The ultimate goal of scientific research and development is to lead us from complexity to simplicity, from challenging to trouble free, from large to small. EECP is such an achievement. As a simple, safe, and effective treatment, there is no place to evolve from EECP. It is both low-tech and the most advanced heart disease treatment we have. It allows physicians to fulfill two of their most important charges: *above all, do no harm* and *help the body heal itself.*

A UNIQUE OPPORTUNITY FOR DOCTOR-PATIENT RELATIONSHIPS

Of course, I am not suggesting that the lifestyle changes and medications so often suggested in books and articles about the newly defined systemic heart disease are unnecessary. They are absolutely critical to a patient's success in living with heart disease in the best possible way. But many heart disease sufferers find it difficult, even

impossible, to change their eating habits, quit smoking, engage in more exercise, and take their medications on their own.

In several ways, EECP offers an exciting opportunity to help patients improve their lifestyle choices and reinforce good habits. First, by increasing their stamina, energy, and overall quality of life, EECP gives patients the ability to be active in a way many could not manage before receiving their treatment. The more they are able to do, the more they want to do, and the more physically active they become. Second, because EECP is provided over a seven-week period, it offers a unique opportunity for the doctor-patient relationship to deepen. The daily visits give patients a chance to develop a genuine sense of trust in their doctor. At the same time, they give doctors a chance to counsel and encourage patients to supplement the benefits they receive from EECP by making healthier lifestyle choices. The physician may offer guidance on quitting smoking, eating a more balanced diet, expanding an exercise regimen, or all three. Whatever the case, and whatever the patient's particular needs, EECP allows a true health partnership to develop. In short, the treatment offers the physi-

cal and emotional setting necessary for patients to get back on the path to good health.

WHY WAIT?

The numerous benefits that EECP offers, combined with the fact that it is the only systemic treatment for the systemic illness of heart disease, begs an important question: why continue to wait until a patient has no other options before giving them a treatment that can slow or even stop the progression of their disease and improve their quality of life? There is no valid answer to this question. In fact, patients around the world are increasingly choosing EECP as their first treatment for heart disease, and science is on their side. A recent United States study compared patients who chose EECP instead of undergoing bypass surgery, angioplasty, or stent placement with patients who were instructed to wait to receive EECP until all surgical and invasive options had been exhausted. It found that the EECP-first patients were less likely to have a heart attack, were less likely to be hospitalized, and enjoyed a greater reduction in angina in the six months following their treatment than patients who received EECP as a last resort.[2] This ground-

breaking study offers clear evidence that using EECP sooner rather than later brings significant clinical and cost benefits. Despite these findings, medical practice has not shifted. EECP is still typically reserved for end-stage, inoperable patients only — a formula that ignores the science and clinical experience that instructs us to do the opposite.

WHAT'S NEXT?

In the United States, most people living with heart disease continue to undergo procedure after procedure, surgery after surgery, test after test, without ever learning that EECP is an option. Every day, I meet patients in exactly this situation. Until they saw a news story, stumbled upon a brochure, or conducted their own research, they were not aware of EECP, let alone that it may be a treatment to consider. There are hundreds of thousands of people across the country just like them, still living without this information.

Why is EECP still unknown? In this and previous chapters, I have discussed many possible explanations, but none of them truly matter anymore. By reading this book, you are participating in a revolution. We can celebrate this wonderful treatment

and all the hope it brings to millions of heart disease sufferers and their loved ones. As more people like you learn about EECP, the treatment will change heart disease management and health care as we know it.

A GLIMPSE OF THINGS TO COME

If we were to use a crystal ball to predict all the ways in which EECP will impact us in the future, the possibilities — actually, the *probabilities* — are nothing short of astounding. With its safety, effectiveness, and a list of uses we have only begun to discover, EECP is a sleeping giant offering a deceptively simple solution to many burgeoning, devastating health problems. It is noninvasive and painless, brings *none* of the risks of surgery, and — if we apply it in even a fraction of the cases where we could — promises to save countless lives and billions of dollars.

EECP allows us to envision a time when the emotional, physical, and economic impact of circulatory diseases will be all but eliminated. With it, patients and their families will no longer be held hostage by the fear, painful symptoms, hospital stays, missed work, or compromised quality of life these conditions currently bring. In

short, it will allow sufferers of a staggeringly wide variety of ailments to spend more time truly *living* and less time in the operating room undergoing painful, costly, risky procedures. In addition to the savings in health-care costs, EECP will return patients to work and other activities, translating into higher productivity and consumption by society at large. EECP is the future of medicine, with the power to transform an entire industry, perhaps even our entire culture. Following are just a few ways it will do so.

Reining in the Number-One Killer

As more people understand the true nature of heart disease and learn about EECP, we will see a profound change in the way heart disease is treated and prevented.

Without question, the future of EECP is as the first treatment for heart disease. Before the bypass, before the angioplasties, before the stents, patients will choose the only logical, noninvasive, risk-free, lower-cost option. This approach, which relegates invasive procedures and surgery to their rightful place as last resorts, is simply common sense. Indeed, many informed Americans are already choosing EECP as

their first treatment, and this trend will only continue to grow as more people learn all the facts about heart disease.

EECP will be used to prevent heart disease. When people are found to have an increased risk of heart disease, EECP will be used to prevent or slow its progression. The treatment promotes the development of collateral blood vessels, strengthens the circulatory system, and trains the heart to work more efficiently. In doing so, it will give potential heart disease sufferers a head start on the illness, thereby delaying and minimizing its effects.

Becoming the Standard Treatment for All Conditions Marked by Poor Blood Flow

As a systemic treatment that maximizes oxygen- and nutrient-rich blood flow throughout the body, EECP's benefits are seemingly limitless. As we have seen, lack of blood flow is the cause or a major contributing factor in numerous diseases responsible for tremendous suffering, disability, death, and expense. EECP will create a considerable shift in current treatments for some of these diseases, and it will provide a treatment where there once was

none for others. Along with many other devastating circulatory disorders, EECP can and will successfully treat:

- Heart disease
- Stroke
- Peripheral vascular disease
- Diabetes
- Hypertension
- Kidney disease
- Parkinson's disease
- Dementia and memory loss (including Alzheimer's disease)
- Neuropathy
- Erectile dysfunction
- Hearing loss and tinnitus
- Vision impairment
- Autoimmune diseases (including Raynaud's phenomenon)
- Mesenteric ischemia
- Avascular necrosis
- Vertigo
- Rheumatic disease
- Restless legs syndrome

Preventing Disease and Enhancing Athletic Performance

By boosting blood flow in a healthy body, EECP improves stamina, endurance, strength, mobility, and vitality. EECP's ability to flush toxins from the body and to serve as an antioxidant and anti-inflammatory agent make it an invaluable partner in the quest for good health. As such, healthy individuals will make EECP an integral part of their lives, using it to supplement exercise regimens, promote overall wellness, and prevent disease.

Of course, athletes form the most elite group of healthy people. We have already begun to see an interest in EECP among professional athletes. In the future, they will continue to expand their use of the treatment to complement training programs, reduce players' risk of injury, and minimize recovery time between workouts. EECP may very well become the secret weapon of athletes looking for an edge.

Case Study

Rocco S., age forty-six, had an extensive history of heart disease. At his young age, he had already suffered three heart attacks and undergone two bypass surgeries (at age forty-four and age forty-five), eleven angioplasties, and six stent placements. Despite all of these surgeries and procedures, he had daily angina with almost all activities, and even while he slept. He had overwhelming anxiety and depression. "I'm a young guy. I can't do anything," he told me. After EECP, his angina decreased in frequency and severity; he went from taking nitro fourteen times a day to only once or twice daily. He had no more fear of his heart disease, and he had much more energy. He was able to coach Little League and volunteer at his church again. "EECP has really changed my life," he said.

WHAT IS AT STAKE?

Heart disease continues to claim one American life every forty-five seconds, while we continue to apply old rules to treat it. It is

the leading killer, the most costly disease, and a primary cause of disability in the United States, but we have the ability to quickly change these facts. The need for EECP has never been greater, and as our population ages, that need will continue to rise exponentially. Embracing the treatment and making it widely available — sooner rather than later in the course of treating an individual's heart disease — would change the entire face of the condition. It is the only way to knock heart disease off its perch as our most deadly and most expensive illness. It is the only humane choice. Hundreds of thousands of lives and hundreds of billions of dollars are at stake. This is a public health issue, an economic issue, and a bioethical issue.

By reading this book, you have taken a critical step in improving your health and the health of your loved ones. Listen to your body. Don't minimize your symptoms or discount the importance of your quality of life. Play an active role in managing your health. Ask questions, and be sure the treatments you receive are in your best interest.

We have the tool. Now we must use it to its fullest. The possibilities are endless.

Endnotes

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Test Your Heart Disease Knowledge: Answer Key

1. True (see the introduction)
2. False (see chapter 7)
3. False (see chapter 7)
4. False (see chapter 7)
5. True (see chapter 7)
6. True (see chapter 7)
7. False (see the introduction)
8. True (see chapter 7)
9. True (see chapter 2)
10. False (see chapter 7)
11. False (see the introduction)
12. True (see chapter 2)
13. False (see the introduction)
14. True (see the introduction)
15. True (see chapter 7)
16. True (see chapter 2)
17. True (see chapter 7)
18. True (see chapter 7)
19. True (see chapter 7)
20. False (see chapter 7)

Frequently Asked Questions

What is angina?

Angina is the variety of symptoms associated with a lack of blood flow to the heart. It occurs when vessels that carry blood to the heart muscle become dysfunctional, and are often narrowed or blocked. Angina may feel like chest pain or pressure; shortness of breath; pain in the jaw, neck, arms, or back; nausea; or generalized fatigue.

What does the acronym EECP stand for?

The acronym EECP stands for enhanced external counterpulsation.

What is EECP?

EECP is a noninvasive, outpatient treatment for heart disease that is used to relieve or eliminate angina. During EECP, blood pressure cuffs are wrapped around your legs, and they squeeze and release in sync with your heartbeat, promoting blood flow throughout your body and particularly to your heart. In the process, EECP develops new pathways around blocked arteries in the heart by expanding networks of tiny

blood vessels ("collaterals") that help increase and normalize blood flow to the heart muscle. For this reason, EECP is often called the "natural bypass."

What are the advantages of EECP?

Unlike bypass surgery, balloon angioplasty, and stenting procedures, EECP is non-invasive, carries no risk, is comfortable, and is administered in outpatient sessions.

Does EECP have any risks or side effects?

EECP is safe. Occasionally, some patients experience mild skin irritation underneath the blood pressure cuffs. Experienced EECP therapists address this irritation by using extra padding where needed to make the patient comfortable. Some patients experience a bit more fatigue at the beginning of their course of treatment, but it usually subsides after the first few sessions. In fact, patients typically feel energized by EECP.

How long does EECP take?

The standard course of treatment is one hour per day, five days per week, for seven weeks (a total of thirty-five one-hour sessions). Some patients have two treatments in one day to complete the program more

quickly. Some patients extend the program beyond thirty-five treatments, depending on their particular medical situation and goals.

How quickly will EECP help me to feel better?

Most patients begin to experience beneficial results from EECP between their fifteenth and twenty-fifth treatments. These benefits include increased stamina, improved sleeping patterns, decreased angina, and less reliance on nitroglycerin and other medications. There is variation, certainly, and some patients start to feel better as soon as their first week of treatment.

What happens if I miss a treatment?

You are encouraged to have your EECP treatment every day. However, missing a day will not have a negative effect on your overall results. When you come back, you will simply pick up where you left off, and the missed treatment will be added to the end of your program until you have a total of thirty-five sessions. Just like exercise, the more consistent you are with your EECP schedule, the better your results will be.

What does EECP feel like?

EECP feels like a deep muscle massage to your legs. During the treatment, you do not feel anything in your chest or heart. You only feel the cuffs that are wrapped around your legs squeezing in time to your own heartbeat. Our patients have affectionately described this sensation as "gentle hugs." Most of our patients relax, listen to music, or read during their treatments. Some even sleep.

Do the benefits of EECP last?

Yes. In patients followed for three to five years after treatment, the benefits of EECP — including less angina, less nitroglycerin usage, and improved blood flow patterns documented on stress tests — had lasted.

How does EECP compare to angioplasty or bypass surgery?

The five-year outcomes for EECP patients are virtually the same as for angioplasty and bypass surgery patients.

Is EECP approved by the FDA? What kind of research has been done on it?

The FDA approved EECP in 1995 as a treatment for coronary artery disease and angina, for cardiogenic shock, and for use

during a heart attack. In 2002, the FDA approved EECP as a treatment for congestive heart failure. EECP has undergone rigorous clinical trials at leading universities around the country and has been the subject of more than a hundred scientific studies published in leading medical journals throughout the world.

Does insurance pay for EECP?
Yes. Medicare and private insurance carriers pay for EECP.

I have a pacemaker. Is that a problem with EECP?
No. Pacemakers and defibrillators do not interfere in any way with EECP.

I am on Coumadin. Is that a problem with EECP?
No. Patients on Coumadin are able to undergo EECP treatments safely.

I have congestive heart failure. Is that a problem with EECP?
No. In fact, in July 2002 the FDA approved EECP as a treatment for congestive heart failure (CHF). After completing a course of EECP treatment, patients with congestive

heart failure typically have less swelling in their legs, less shortness of breath, and less fatigue, and they often require less diuretic medication.

Is there an age limit for EECP?

No. We have successfully treated patients as young as thirty-six and as old as ninety-seven without any difficulties. Many of our patients are in their eighties and nineties, and they complete the entire EECP program with excellent results.

I have already had bypass surgery/ angioplasty/stents. Can I still have EECP?

Yes. Most of our patients have already had one (or many) of these procedures. They come for EECP treatment because they still have angina.

Can EECP dislodge plaque and cause a stroke or heart attack?

No. Our bodies obey the laws of physics, and one principle law is that fluid will follow the path of least resistance. Atherosclerotic plaques are calcified and hard, and they create an obstruction that detours the blood through alternate routes. During EECP, when your blood is flowing to your heart, it will naturally bypass ar-

teries with plaque and enter healthy, non-diseased blood vessels to go around the blockages. Going around the blockages is a longer trip, but it is a much easier one. In time, these new pathways are reinforced and become lasting routes for blood to reach your heart beyond the blockages. Every EECP patient has had multiple, serious blockages. No one has ever had a heart attack or a stroke as a result of the treatment.

Are there any patients who *cannot* have EECP?

There are very few patients who are unable to have EECP. Those who should not be treated include pregnant women, individuals with a severe leakage in their aortic valve requiring surgical repair, and patients who have an active blood clot in their leg.

I had a blood clot in my leg three years ago. Can I have EECP?

Yes. Having a history of a blood clot (deep vein thrombosis, or DVT) in your leg does not preclude you from having EECP. It is recommended that you have a Doppler ultrasound of your leg to confirm that the blood clot has resolved before beginning the EECP program.

Does EECP aggravate high blood pressure (hypertension)?

No. If you have hypertension that is properly managed, you may undergo EECP without difficulty. Oftentimes, patients with hypertension find that their blood pressure improves as they proceed with EECP. If your hypertension is uncontrolled, you must seek medical care to get your blood pressure under control with proper medications before proceeding with EECP.

I have poor circulation in my legs (peripheral vascular disease, or PVD). May I still have EECP?

Yes, and you should! EECP improves blood flow throughout the entire body, including your legs. If you have poor leg circulation, you might need more than thirty-five treatments. My patients with poor leg circulation typically require at least fifty treatments to get the full benefit of the program. In addition to improved stamina, less angina, and less nitroglycerin use, patients with peripheral vascular disease have a marked improvement in their leg circulation in response to EECP.

I have atrial fibrillation and an irregular heartbeat. May I still have EECP?

Yes. An irregular heartbeat, including one caused by atrial fibrillation, will not interfere with EECP if the heart rate is controlled and no faster than one hundred beats per minute.

I have varicose veins. May I still have EECP?

Yes. Varicose veins are typically a cosmetic issue, not a medical one. As such, they do not preclude individuals from receiving EECP. We often use extra padding with patients who have varicose veins to ensure maximum comfort.

What happens if my angina returns months or years after I finish my EECP treatment course? Can I come back for more?

Yes. EECP is not a once-in-a-lifetime treatment. Heart disease is a chronic illness, and symptoms may return at some point in the future. The door is always open for you to return for additional courses of EECP as needed.

Is EECP similar to chelation therapy?

No. There is no relationship between EECP and chelation therapy. Chelation is an invasive procedure whereby a substance called EDTA is given intravenously in an attempt to bind to calcium and remove it from atherosclerotic plaques. The fundamental problem with the concept of chelation is that atherosclerotic plaques are not only made of calcium; they include fat, cholesterol, and cellular deposits as well. Scientific research has not shown chelation to have any therapeutic value for heart disease. Since it has never been proven to work, Medicare and insurance carriers do not pay for chelation, and therefore it is not accessible to most heart disease patients. Patients who choose to try it must pay out of pocket. Each treatment costs approximately eighty to one hundred dollars, and patients often go for numerous treatments over a period of several months and then continue indefinitely on a maintenance regimen. Chelation can actually be harmful — even fatal — when administered to the wrong person or under the wrong circumstances. It poses particular danger to individuals with congestive heart failure. The amount of fluid administered with each treatment may overtax their weakened

heart, leading to severe fluid overload and problems including pulmonary edema (a life-threatening condition that is characterized by an excess of fluid in the lungs).

In contrast, EECP is entirely noninvasive, proven by more than a hundred published scientific studies, and safe. It is an accepted, mainstream medical treatment and, as such, is approved by Medicare and covered by insurance. Chelation does not interfere with EECP, so you may undergo both therapies simultaneously if you choose.

Is there a difference between EECP and ECP?

Yes. EECP and ECP are uniquely different. EECP is a registered trademark of Vasomedical, Inc., the leading manufacturer of EECP equipment in the United States. Vasomedical has a patent on the EECP machine's timing mechanism, which determines when the cuffs squeeze and release in time to the patient's EKG — the most critical part of the treatment. This timing mechanism makes the EECP machine by far the most clinically effective device on the market, distinguishing it from other external counterpulsation (ECP) equipment. Every published U.S. study (more than one

hundred of them) and most studies originating in countries around the world and published in the leading English-language medical journals have used EECP equipment exclusively. Accordingly, EECP — not ECP — machines are the ones found in every university hospital, major community hospital, and well-known practice that offers the treatment.

Braverman EECP Heart Centers

Braverman EECP Heart Centers (formerly VitalHeart EECP Clinics) is the largest EECP practice in the United States and the only one solely dedicated to the treatment. In its offices throughout the Philadelphia area, the practice has treated more than two thousand patients with EECP. Its website is a comprehensive source of information on EECP, including thorough descriptions of the treatment, news updates, clinical studies, patient testimonials, and more. The website also features an "Ask the Doctor" section, where you may email Dr. Braverman directly with your questions.

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Vasomedical, Inc.

Vasomedical, Inc. is the leading manufacturer of EECP equipment in the United States. EECP is currently available in more than 650 locations throughout the United States, as well as in twenty-four countries around the world. To find a location near you, call Vasomedical's toll-free number: (800) 455-EECP. Vasomedical's website is also a good source of information for both patients and physicians about all aspects of EECP.

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International EECP Therapists Association

The International EECP Therapists Association (IETA) is a multidisciplinary organization of EECP therapists dedicated to setting standards of excellence in the delivery of enhanced external counterpulsation. Its website offers information for pa-

tients and their families, as well as professional development guidance for EECP therapists. IETA is an excellent resource for EECP therapists with clinical questions or concerns about providing the most effective treatment to particular patients with individual needs.

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International EECP Patient Registry

The International EECP Patient Registry (IEPR) is a volunteer patient registry at the University of Pittsburgh's Epidemiology Data Center. The study enrolls patients receiving EECP treatment and follows them for several years to measure their outcomes. The IEPR has published many groundbreaking studies documenting EECP's long-term benefits, including reduced angina, improved quality of life, and reduced nitroglycerin use. Its studies also focus on subpopulations of heart disease patients, including the elderly, women, those with congestive heart failure, and

those with diabetes. The IEPR's website offers access to numerous research publications on EECP.

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Mended Hearts

Mended Hearts is a national nonprofit organization dedicated to facilitating patient-centered care for heart disease sufferers. Its services — which include educational forums, support groups, and visiting programs — are offered to patients, their families and caregivers, and others impacted by heart disease. Mended Hearts' mission is to "inspire hope in heart disease patients and their families." It is affiliated with the American Heart Association and offers its programs in partnership with 460 hospitals and rehabilitation clinics across the country.

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American Heart Association

The American Heart Association is a national voluntary health agency whose mission is to reduce disability and death from cardiovascular diseases and stroke. It is a comprehensive educational resource, providing information on warning signs, management tools, treatments, healthy lifestyle choices, children's health, and much more. Through its website, the American Heart Association offers a wealth of information about cardiovascular disease, as well as extensive data on its social and economic impact on various populations and racial and ethnic groups.

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Glossary

Abdominal aortic aneurysm (AAA). A localized, saclike widening of the abdominal aorta due to a weakness in the blood vessel wall.

Angina/angina pectoris. The symptom that indicates the heart is not receiving enough blood and oxygen. Commonly, angina is experienced as chest pain, chest pressure, and/or chest tightness. See also "Anginal equivalents."

Anginal equivalents. Symptoms other than chest pain that indicate the heart is not getting enough blood and oxygen. These symptoms include shortness of breath; fatigue; decreased exercise tolerance; nausea; vomiting; burning or discomfort in the chest or throat; pain in the jaw, neck, arms, upper back, or shoulder blades; or palpitations.

Angiogenesis. The growth of new blood vessels. These vessels help to alleviate coronary artery disease by rerouting blood flow around clogged arteries so it can reach the heart.

Angiogram. The clinical report that results from an angiography or cardiac catheterization.

Angiography. See "Catheterization, cardiac."

Angioplasty. Also called *percutaneous transluminal coronary angioplasty* (PTCA). A procedure in which a balloon is inserted into the center of a blockage in an artery and inflated in order to crack the plaque and push the blockage out to the perimeter of the artery.

Anticoagulant. A blood-thinning medication that prevents blood from clotting.

Aorta. The largest artery in the body. All blood pumped out of the heart's left ventricle travels through the aorta on its way to other parts of the body.

Aortic insufficiency (AI). Also called *aortic regurgitation* (AR). An aortic valve leakage that does not allow for complete valve closure. As a result, blood flows back into the left ventricle (regurgitation) rather than through the aorta and into the coronary arteries.

Aortic regurgitation (AR). See "Aortic insufficiency."

Aortic valve. The valve between the left ventricle and the aorta. Closure of the aortic valve signals the end of systole and the beginning of diastole.

Arrhythmia. An irregular heartbeat.

Arteries. Blood vessels that carry oxygenated blood away from the heart and throughout the body.

Atherosclerosis. Also known as "hardening of the arteries." The process whereby deposits of fat, cholesterol, and plaque build up in arteries, leading to the blockages in coronary artery disease and other cardiovascular problems.

Atrial fibrillation ("A-fib"). A condition in which chaotic activity in the upper chambers of the heart results in a disorganized, rapid, and irregular heart rhythm.

Atrium. An upper chamber of the heart. (Plural: atria.)

Augmentation. The increase in diastolic blood pressure that occurs as a result of the inflating EECP cuffs and the subsequent creation of a retrograde (from the legs up to the heart) arterial pressure wave.

Autoimmune. A condition in which the body's immune system fights against the body's own tissues.

Blood pressure. The force of pressure exerted by the heart when pumping blood. Also, the pressure of blood against the artery walls.

B-type natriuretic peptide (BNP). Also known as *plasma brain natriuretic peptide*. A substance secreted by the ventricles of the heart in response to changes in blood pressure that occur during heart failure.

Bypass surgery. See "Coronary artery bypass graft."

CABG. See "Coronary artery bypass graft."

CAD. See "Coronary artery disease."

Cardiac. Relating to the heart.

Cardiac cycle. The sequence of events between one heartbeat and the next, normally occupying less than one second. See also "Diastole" and "Systole."

Cardiac output. The amount of blood ejected by the heart in one minute. (The average amount in a healthy adult is four to six liters per minute.)

Cardiomyopathy. A condition in which the heart may have poor pumping power ("dilated"), have an impaired ability to fill

with blood ("restricted"), or be thickened ("hypertrophic").

Cardiovascular disease. A family of diseases of the heart and circulatory system, including hypertension, coronary artery disease, stroke, and congestive heart failure.

CAT scan. See "Computed tomography."

Catheterization, cardiac. Also called *angiography.* A procedure in which a catheter is inserted into an artery in the arm or leg and is guided to the heart, contrast dye is injected, and X-rays of the coronary arteries, heart chambers, and valves are taken so that blood circulation can be studied and blockages in arteries can be identified.

Cerebral vascular accident (CVA). Also known as *stroke.* A complete blockage in a cerebral artery (a blood vessel in the brain), commonly due to a ruptured plaque and the resulting blood clot or an embolus. May also be caused by a hemorrhage (or bleeding) in the brain.

CHD. See "Coronary heart disease."

CHF. See "Congestive heart failure."

Chronic stable angina. See "Stable angina."

Claudication. A symptom of peripheral vascular disease (poor leg circulation), most commonly leg pain or fatigue due to a poor supply of blood and oxygen in the muscles.

Collateral blood vessels. Small vessels that develop over time in response to increased blood flowing through them; often a result of narrowed coronary arteries. Collaterals naturally bypass the narrowed area and restore blood flow to the heart, beyond the blockage.

Computed tomography (CT, CAT scan). A diagnostic imaging procedure that uses a combination of X-rays and computer technology to produce detailed, cross-sectional images of any part of the body.

Congestive heart failure (CHF). The condition in which the heart muscle is weak and fails to pump sufficient blood throughout the body. It leads to fluid buildup and associated symptoms such as shortness of breath and swelling in the legs.

Coronary. Relating to the heart.

Coronary artery bypass graft (CABG). Also known as "open-heart surgery" or "bypass surgery." A surgical procedure

utilizing an artery or vein graft to bypass a blockage in a coronary artery.

Coronary artery disease (CAD). The narrowing or "hardening" of the arteries that supply blood to the heart muscle, usually caused by a buildup of fats, cholesterol, and calcium (atherosclerosis).

Coronary heart disease (CHD). A disease of the heart caused by a lack of blood flow due to coronary artery disease.

Coumadin. The brand name for warfarin. An anticoagulant, or blood-thinning, medication.

C-Reactive protein (CRP). A protein the liver produces that is present in the blood during episodes of acute inflammation. Elevated levels have been linked to many conditions associated with inflammation, including coronary artery disease.

CT scan. See "Computed tomography."

Deep vein thrombosis (DVT). A blood clot (thrombus) in a deep vein. It most commonly occurs in the legs, and may also rarely occur in the pelvis or arms.

Diabetes. A condition in which the body does not produce or respond appropriately to insulin, the hormone produced by the pancreas that enables blood sugar to enter

the cells and be used for energy.

Diastole. The resting phase of the cardiac cycle, during which the heart receives 70 to 80 percent of its blood supply. It begins with the closure of the aortic valve.

Diastolic augmentation. A measure of blood flow in the arteries of the heart.

Diastolic blood pressure. The lowest blood pressure measured in the arteries, occurring between heartbeats.

Diuresis. The process by which the body rids itself of excess fluid. It may be assisted by the use of diuretic medications.

Diuretic. A medication that lowers blood pressure by stimulating the kidneys to rid the body of excess fluid. Commonly known as a "water pill."

Doppler ultrasound. A noninvasive diagnostic test that uses sound waves to evaluate the heart and blood vessels.

DVT. See "Deep vein thrombosis."

ECG. See "Electrocardiogram."

Echocardiogram ("Echo"). A noninvasive imaging procedure that creates a moving picture outline of the heart's valves and chambers using high-frequency sound waves (ultrasound).

Edema. A swelling. An excess accumulation of fluids, usually in the feet and legs. It may also occur in the hands or abdomen.

EECP. See "Enhanced external counterpulsation."

Ejection fraction. The ratio of blood that is pumped with each beat of the heart to the volume of blood that fills the heart between beats. It is expressed as a percentage.

EKG. See "Electrocardiogram."

Electrocardiogram (EKG or ECG). A recording of the heart's electrical activity.

Embolus. A blood clot that moves through the bloodstream.

Endothelial cells. The cells that line blood vessels and are actively involved in regulating blood flow.

Endothelin (ET-1). A substance released by endothelial cells that causes blood vessels to constrict.

Enhanced external counterpulsation (EECP). A noninvasive treatment for heart disease that increases blood flow to the heart, improves heart muscle function, decreases the heart's workload, and decreases resistance to the heart's pumping action. During EECP, blood pressure cuffs

wrapped around the patient's legs inflate and deflate in sync with their heartbeat, enhancing blood flow throughout the body.

Heart attack. See "Myocardial infarction."

Heart disease. A generic term comprising all of the various diseases of the heart. Commonly refers to coronary artery disease and/or coronary heart disease.

Heart failure. The condition in which the heart muscle is weak and unable to pump sufficient blood to meet the body's needs.

Hypertension (HTN). High blood pressure.

Implantable cardioverter defibrillator (ICD). A surgically inserted electronic device that constantly monitors heart rate and rhythm. When it detects a potentially dangerous arrhythmia, it delivers an electrical shock to the heart muscle (cardioversion), causing the heart to beat in a normal rhythm again.

International normalized ratio (INR). The standard measurement of coagulation in the blood, commonly used to regulate Coumadin dosage.

Ischemia. The deficiency of blood supply and oxygen delivery, signaling that oxygen demand is greater than supply.

Myocardial infarction (MI). Commonly referred to as a *heart attack.* It occurs when one or more of the coronary arteries are suddenly and completely blocked, causing an area of the heart muscle to die.

Myocardial perfusion. The blood flow patterns in the heart muscle.

Myocardium. The heart muscle.

Nitric oxide (NO). A substance released by endothelial cells that causes blood vessels to relax and dilate.

Nitroglycerin (NTG). A medication that dilates blood vessels (vasodilator), improving blood flow.

Occlusion. A blockage.

Open-heart surgery. See "Coronary artery bypass graft."

Pacemaker. A surgically implanted electronic device that sends electrical impulses to the heart muscle to maintain a stable heart rate and rhythm.

Palpitation. A fluttering sensation in the chest that is often related to a missed heartbeat or a rapid heartbeat.

PCI. See "Percutaneous coronary intervention."

Percutaneous coronary intervention (PCI). An invasive procedure in which a catheter and a guide wire are inserted into a peripheral artery (usually in the groin) and threaded to a blockage in a coronary artery. Once there, an angioplasty, stent implantation, or other procedure is performed.

Percutaneous transluminal coronary angioplasty (PTCA). See "Angioplasty."

Peripheral vascular disease (PVD). Diseases of blood vessels outside the heart and brain, most commonly involving atherosclerotic narrowing of arteries that bring blood to the legs.

PET scan. See "Positron emission tomography."

Plaque. Deposits of fats, cholesterol, inflammatory cells, proteins, and calcium in the lining of arteries, which cause narrowing and slow blood flow.

Plasma brain natriuretic peptide (BNP). See "B-type natriuretic peptide."

Positron emission tomography (PET). Nuclear scanning that creates a three-dimensional picture of blood flow through the coronary arteries to the heart muscle.

Premature ventricular contraction (PVC). An irregular heartbeat in which the ventricles beat before they are supposed to.

PTCA. Percutaneous transluminal coronary angioplasty. See "Angioplasty."

PVD. See "Peripheral vascular disease."

Refractory angina. Persistent, severe angina in patients who are considered inoperable and on maximum medications.

Restenosis. The closing or narrowing of an artery that was previously opened by a PCI, such as an angioplasty or a stent.

Risk factor, cardiac. A condition, element, or activity that may adversely affect the heart.

Silent ischemia. Ischemia without symptoms.

Stable angina. Also called *chronic stable angina.* Angina that occurs at predictable times, at predictable levels of exertion or activity, and usually lasts twenty to thirty minutes or less. May continue without significant change for years. Rest and/or nitroglycerin provide short-term relief.

Stenosis. The narrowing or restriction of a blood vessel, which reduces blood flow.

Stent. A scaffoldlike metal device inserted into a blockage in an artery and expanded in order to allow blood to flow through the vessel.

Stress test. An exercise test that examines how well the heart works, during which patients walk on a treadmill to increase their heart rate while their EKG is monitored for any abnormalities.

Stroke. See "Cerebral vascular accident."

Stroke volume. The volume of blood pumped by the heart in one heartbeat.

Systemic vascular resistance (SVR). The resistance blood encounters as it flows out of the left ventricle of the heart and throughout the body.

Systole. The contraction, or "pumping," phase of the cardiac cycle.

Systolic blood pressure. The highest pressure measured in the arteries; it occurs during a heart muscle contraction.

Thallium stress test. A stress test in which a radioactive substance is injected into and carried by the blood, and its progress through the circulation of the heart is followed by X-ray.

Thrombophlebitis. The inflammation of a vein, often in conjunction with a blood clot. It commonly occurs in the superficial veins of the legs.

Thrombus. A blood clot.

Ultrasound. A noninvasive diagnostic tool used to provide a moving picture of an area of the body by measuring high-frequency sound vibrations.

Unstable angina. Angina that is different than usual in terms of severity, duration, and or type of symptoms. It occurs without exertion or with decreasing levels of exertion.

Vascular endothelial growth factor (VEGF). A hormone that promotes the growth of new blood vessels.

Vasoconstrict. To narrow a blood vessel, causing a decrease in blood flow to a particular area of the body.

Vasoconstrictor. A medication or substance that causes vasoconstriction.

Vasodilate. To relax and dilate a blood vessel, causing an increase in blood flow to a particular area of the body.

Vasodilator. A medication or substance that causes vasodilation.

Vasospasm. The sudden constriction of a blood vessel due to a muscular spasm of the vessel wall.

Veins. Blood vessels that carry deoxygenated blood toward the heart.

Ventricles. The two bottom chambers of the heart that pump blood into the arteries.

Warfarin. The generic name for Coumadin.

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